Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT

Aviation Occurrence Investigation – AO-2007-018

Final

Total power loss
Cecil Park, NSW
5 February 2007
VH-HYY, Cirrus SR22

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Abstract

On 5 February 2007, a Cirrus SR22 aircraft, registered VH-HYY, with a pilot and one passenger on board, was being operated on a private flight from Canberra, ACT to Bankstown, NSW. As the aircraft approached the Cecil Park area, NSW, the pilot reported to air traffic control that the engine had lost power and he was attempting a forced landing. Soon after, the aircraft impacted terrain close to the M7 motorway and both occupants sustained serious injuries.

The investigation determined that the engine stopped due to the in-flight loss of a blanking cap from the un-metered fuel pressure test port in the engine fuel system. Testing showed that the engine would not operate with the cap missing.

The investigation determined that, instead of the normal steel cap, a plastic blanking cap had probably been fitted to the test port on the engine during maintenance and had been inadvertently left there, and that the plastic cap had detached from the test port just prior to the accident.

Prior to impact, the pilot activated the Cirrus Airframe Parachute System (CAPS), but the system malfunctioned and the parachute did not deploy correctly.

Following examination of the CAPS components from this aircraft and further functional testing of production CAPS components in the US, the aircraft manufacturer issued an Alert Service Bulletin incorporating design changes to the CAPS in the worldwide fleet of Cirrus aircraft.

The aircraft and engine manufacturers are also making a number of other changes to their processes and procedures based on lessons learnt from this accident.

The Australian Transport Safety Bureau will forward copies of this report to the relevant state emergency authorities to alert them to the dangers posed by ballistic parachute systems in light aircraft.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Services and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, risk controls and organisational influences.

Contributing safety factor: a safety factor that, if it had not occurred or existed at the relevant time, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Safety issues can broadly be classified in terms of their level of risk as follows:

- **Critical safety issue**: associated with an intolerable level of risk.
- **Significant safety issue**: associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable.
- **Minor safety issue**: associated with a broadly acceptable level of risk.

FACTUAL INFORMATION

History of the flight

On 5 February 2007, a Cirrus SR22 aircraft, registered VH-HYY (HYY), with a pilot and one passenger on board, was being operated on the return segment of a private NOSAR/no details[1] flight from Canberra, ACT to Bankstown, NSW under the visual flight rules (VFR). At approximately 1616 Eastern Daylight-saving Time[2], as the aircraft approached Cecil Park, NSW, at a height of 800 ft above ground level (AGL), the pilot reported to air traffic control (ATC) that the engine had lost power and he was attempting a forced landing. Soon after, the aircraft impacted terrain close to the M7 motorway (Figure 1). Both occupants sustained serious injuries and the aircraft was seriously damaged[3].

Figure 1: Aerial view of accident site and the M7 motorway

Witness reports

Witnesses reported that the aircraft appeared to be attempting to land on the M7 motorway, but, just prior to impact, it veered away from the road to the right and struck the ground in a nose-down, right wing-low attitude.

One witness, who was travelling south on the motorway, reported that it was ‘coming straight at him low over the road’ and that there had been ‘an explosion in

1 A NOSAR/no details flight is a flight for which no flight plan has been lodged with air traffic services.

2 The 24-hour clock is used in this report. Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

3 The Australian Transport Safety Regulations 2003 definition of ‘seriously damaged’ includes destruction of the transport vehicle.

front of the propeller, smoke and sparks coming from the left side of the aeroplane and white pieces falling from the aircraft onto the centre of the road [median strip]'.

Another witness, who had been travelling north on the motorway and had been behind the aircraft, reported that it appeared to be preparing to land in the north-bound lane of the motorway, but suddenly banked steeply to the right just prior to impacting trees and terrain. He recounted having heard a bang 'like a car backfiring' and that a piece of the aircraft had fallen onto the road. This witness also reported seeing another person, who had stopped on the motorway, remove the piece of aircraft from the road and place it into their car.

The passenger, who was in the right front seat of the aircraft at the time of the accident, indicated that the engine failure was 'sudden' and that the pilot had activated the Cirrus Airframe Parachute System (CAPS).

Injuries to persons

Both occupants received serious injuries during the accident. As a result, the pilot had no recollection of events preceding the accident.

Pilot information

The pilot had a total of 262.4 hours flying experience, of which 153.9 hours were as pilot in command. He was experienced in the operation of the Cirrus SR20/22 aircraft and had a total of 140.2 hours on type.

At the time of the accident, he held a valid US private pilot's licence issued on 27 July 2003 and had completed a flight review in the US on 26 October 2006. He held an Australian Special Pilot Licence and a Flight Radiotelephone Operator Licence, both issued on 1 April 2004. The Australian Special Pilot Licence remained valid as long as the pilot held a valid US licence.

The pilot held endorsements on his Australian Special Pilot Licence for single-engine aeroplanes under 5,700 kg maximum take-off weight and variable pitch propellers. He also held a valid Third Class medical certificate issued by the US Federal Aviation Administration (FAA) on 26 September 2006.

Communications

Air Traffic Control information

Records of ATC radio communications and radar data were examined for the latter part of the flight. Exchanges between the pilot and the Bankstown Aerodrome Controller (ADC) are summarised in Table 1.

Table 1: Summary of radio communications

Time (EDT)	From	To	Comments
16:16:00	HYY	ADC	The pilot of HYY reported an emergency to ATC stating that the engine had lost power.
16:16:11	ADC1	HYY	ATC acknowledged the pilot's transmission and requested his position.
16:16:15	HYY	ADC	The pilot reported he was over a freeway.
16:16:22	HYY	ADC	The pilot reported that he was going to attempt to land on the freeway.
16:16:33	HYY	ADC	At approximately 400 ft AGL, the pilot reported that he was going to 'deploy the parachute' [CAPS].
16:16:41	ADC1	HYY	ATC requested the aircraft's location to deploy emergency services, but no further response was received from the pilot.

The radar data showed that the engine failure occurred while the aircraft was maintaining an altitude of 1,200 ft AGL[4], while positioning to overfly the Prospect VFR approach point for a landing at Bankstown Airport. The pilot reported the engine failure to ATC a short time later when the aircraft was at 800 ft AGL.

Emergency locator transmitter

The aircraft was fitted with an ACK Technologies emergency locator transmitter (ELT) situated in the fuselage behind the rear wall of the baggage compartment. The ELT operated following the impact and alerted AusSAR[5] to the accident.

Meteorological information

The Bureau of Meteorology (BoM) reported that the recorded weather conditions at the time and location of the accident were: surface wind 090 to 112 degrees at 12 to 16 kts on average, gusting to 23 kts; temperature 28° to 30° C; and dew point 15° C. No significant cloud or reduction in visibility was observed within 30 km of the accident site.

Aircraft information

The Cirrus SR22 was primarily of fibreglass composite construction. The aircraft was fitted with dual flight controls.

4 The radar display data tolerance for pressure altitude-derived level information displayed is +/- 200 ft.

5 Australian Search and Rescue.

The design incorporated an integral roll cage around the occupants. The seats and seat belt assemblies were designed to withstand a forward impact of 26g[6] and a vertical impact of 19g. A whole-of-aircraft recovery parachute system (CAPS) was fitted as standard equipment.

Table 2: Summary of aircraft details

Aircraft manufacturer	Cirrus Design Corporation
Model	SR22
Serial number	928
Registration	VH-HYY
Year of manufacture	2004
Aircraft total airframe hours	Approximately 710.5
Date of last maintenance	24 January 2007 at 705.1 hours total time in service
Last maintenance type	Engine and propeller re-fitment
Maintenance release (hours and date)	A57146; valid to, 6 October 2007 or at 794.0 hours time in service
Engine manufacturer	Teledyne Continental Motors
Model	IO-550N-27B
Serial number	917232
Manufacture date	26 March 2004
Date of last maintenance	24 January 2007
Hours remaining before overhaul	1,289.4 hours total time in service
Flight hours since engine re-installation	5.4 hours

The aircraft underwent regular maintenance checks and non-scheduled repairs, and its log books showed that it had been maintained by the same maintenance organisation since 12 September 2006.

On 6 October 2006, at 694.0 hours, a 100-hourly periodic inspection was undertaken by the current maintenance organisation. The maintenance organisation certified it had carried out Teledyne Continental Motors (TCM) Service Information Directive SID 97-3[7] during this inspection.

On 14 October 2006, at 705.1 hours, the engine and propeller were damaged during a heavy landing and propeller strike incident at Bankstown Airport.

On 18 October 2006, at 705.1 hours, the aircraft's engine and propeller were removed for examination and re-build.

6 1'g' is the acceleration due to the Earth's gravity, the international standard value being 9.80665 m/s^2

7 Teledyne Continental Aircraft Engine, Service Information Directive, SID 97-3C, Procedures and Specifications for Adjustment of Teledyne Continental Motors (TCM) Continuous Flow Injection Systems, issued 24 March 1997, with current revision dated 25 February 2005.

On 18 January 2007, at 705.1 hours, a heavy landing inspection was carried out. That inspection did not require checking of the CAPS components in the rear section of the fuselage.

On 24 January 2007, at 705.1 hours, the rebuilt engine and an overhauled propeller were installed and the installation was certified as carried out in accordance with the Cirrus SR22 *Aircraft Maintenance Manual*.

Flight information

The total usable fuel for the Cirrus SR22 aircraft was 306.6 L.

HYY was carrying full fuel on departure from Bankstown. The flight to Canberra was uneventful and took approximately 58 minutes. At Canberra, the pilot fully fuelled the aircraft, adding 67.1 L to the wing tanks. The return flight was approximately 53 minutes.

For the above flights, the pilot operated the engine at 'full rich'[8]. This had been specified by the aircraft's owner following consultation with several engine workshops in order to preserve the condition of the recently re-built engine. On the basis of its fuel consumption on the Bankstown to Canberra segment, HYY would have used approximately 61 L from Canberra to the time the engine stopped, leaving approximately 246 L at the time of the accident.

The weight of HYY at the time of the accident was estimated to be 1,359 kg (3,060.9 lb). The aircraft was calculated to be within its centre of gravity envelope and weight limits for the duration of the flight.

Wreckage information

An examination of the wreckage indicated that the aircraft struck several trees before heavily impacting rising terrain in a right wing-down, nose-low, attitude. Following the initial impact, the aircraft travelled for a further 10 m up a 25 degree incline before coming to rest in an upright position.

The impact completely detached the right main landing gear assembly and fractured the fibreglass laminate structure of the left main landing gear. Both wings were extensively damaged and both internal wing fuel tanks were breached. The engine mounts were fractured and the engine moved rearward, damaging the engine firewall. The impact partially crushed the foot well areas and rudder pedal assemblies on both sides of the cockpit.

The rear fuselage and empennage assembly broke away from the main fuselage at a point behind the rear baggage compartment and came to rest alongside the main wreckage (Figure 2). The flight control cables between the rear fuselage and the main wreckage remained intact.

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8 Normally, an aircraft piston engine is 'leaned' once the aircraft is in cruise flight. This means the ratio of the fuel:air mixture is adjusted for maximum fuel efficiency. 'Full rich' means that the mixture is in the maximum fuel rich state.

An examination of the aircraft wreckage and surrounding area indicated:

- the fibreglass CAPS cover, normally situated over the CAPS parachute exit point on the top rear of the fuselage, was missing (and not found);
- the CAPS had been activated and the parachute had failed to deploy;
- all flight controls were intact and correctly connected;
- both aircraft wing tanks had been breached and there was a strong smell of aviation gasoline beneath the aircraft;
- ground scars and damage to the propeller indicated that it was not rotating under engine power at impact; and
- emergency services personnel had cut the cabin roof structure in two places to facilitate the recovery of the injured passenger from the aircraft.

Figure 2: Aircraft wreckage

Engine examination

The engine installed in HYY normally had a threaded flared-tube T-fitting with a steel cap fitted in the engine's fuel injection system. Fuel passed through this fitting to the fuel control unit (FCU). The steel cap was a manufacturer-approved part (Part number - 639494[9]) and was an integral part of the engine.

The T-fitting incorporated a test port to be used while checking the un-metered fuel pressure[10] during maintenance. The un-metered fuel pressure of the TCM IO-550-N

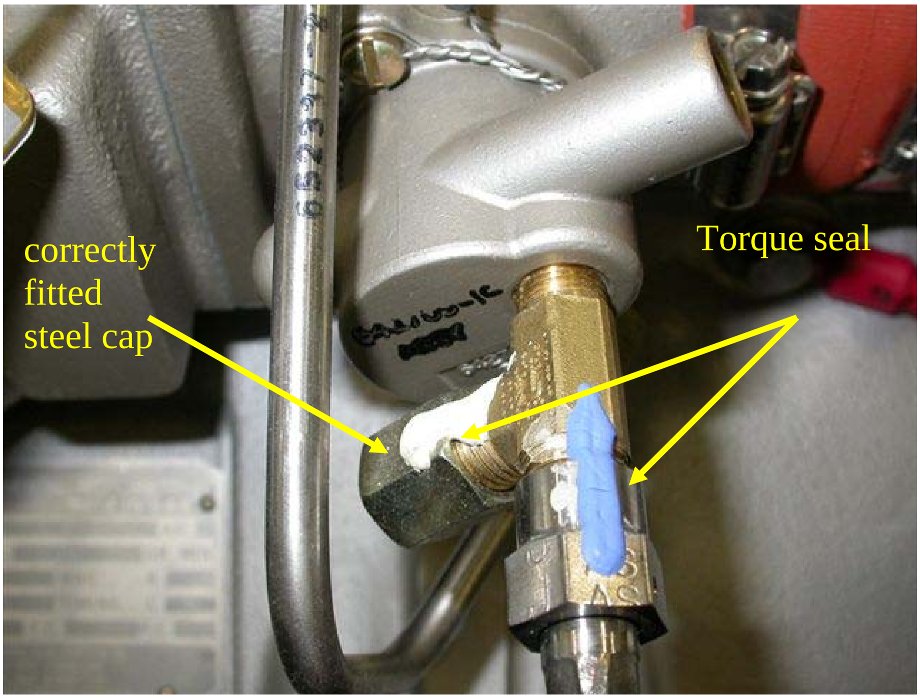
9 As detailed in the engine manufacturer's parts catalogue for the engine.

10 'Un-metered fuel pressure' means the pressure of the fuel from the engine driven fuel pump (EDP) before it passes into the fuel control unit.

engine was normally 28 to 32 Psi. At all other times, the test port should have been sealed by the steel cap.

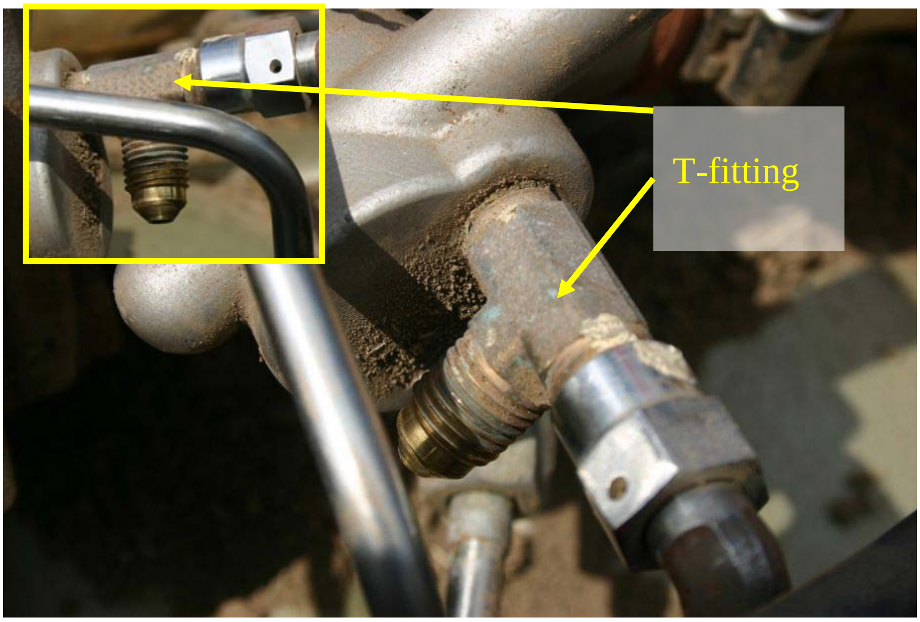
The steel cap was normally tightened over the T-fitting to a specified torque to ensure it remained secure. A mark comprising of inspection lacquer (Torque Seal™) was painted onto the cap and metal. Any breakage of the inspection lacquer mark would indicate the steel cap had moved relative to the metal fitting (Figure 3).

Figure 3: IO-550-N T-fitting installation



An examination of the engine on HYY noted that the steel cap from the T-fitting on the engine-mounted fuel injection system was missing (Figure 4).

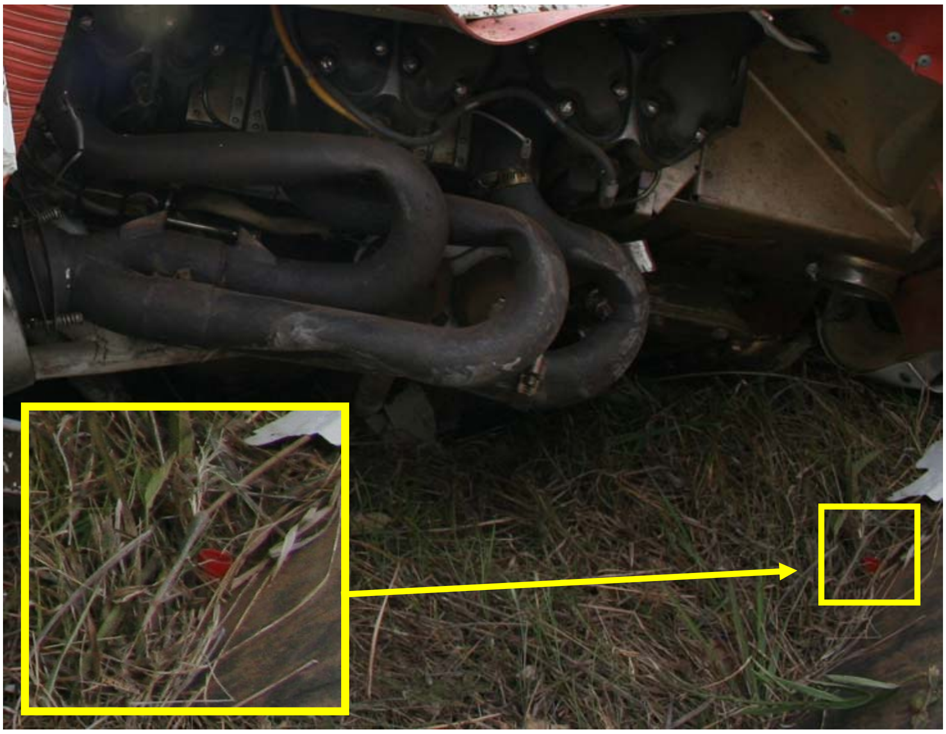
Figure 4: The T-fitting on HYY without its associated steel cap



A small red plastic blanking cap, with the same thread type and diameter as the T-fitting, was found beneath the engine on the ground, adjacent to the remains of the fibreglass lower engine cowl (Figures 5 and 6).

Figure 5: Red plastic blanking cap location

Figure 6: Detail of red plastic blanking cap location



Engine testing

Following the accident, the engine was taken to an engine overhaul facility for examination and testing. Due to accident damage to the crankshaft flange, the engine was started and run for short periods only at low power settings. The engine functioned normally with the test port on the un-metered fuel T-fitting completely sealed, but it stopped within 3 seconds each time the blanking cap was removed from the test port. No other anomaly that would have prevented normal engine operation was found.

Red plastic blanking cap

An examination of the red plastic blanking cap indicated it was manufactured from injection-moulded low-density polyethylene (LDPE). Identifiers on the head of the cap indicated that it had been made by Kelvindale Products Pty Ltd, part number CD04.

The Kelvindale data sheet recommended that LDPE plastic plugs [caps] should not be exposed to temperatures above 66° C for continuous use, although they may be used intermittently at temperatures up to 79° C. The Material Safety Data Sheet for LDPE stated that the melting range for LDPE was 106° to 112° C.

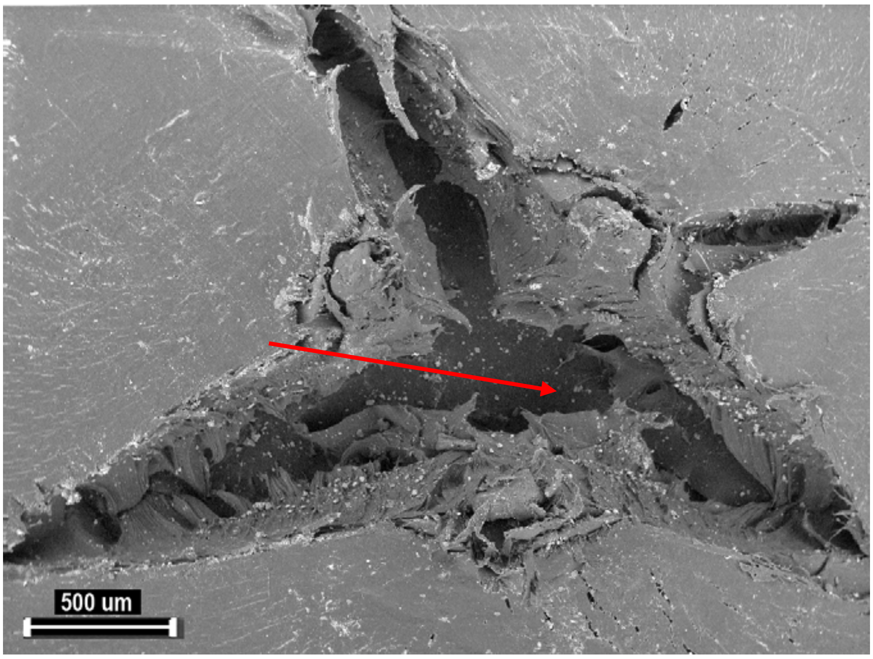
Visual examination of the plastic blanking cap revealed obvious distortion and cracking around the cap head. The central part of the cap had bulged outward. The amount of deformation is apparent by comparing the cap from HYY to an unused plastic cap of the same type (Figure 7).

Figure 7: Red plastic blanking cap from HYY (left) beside an unused cap

Four principal cracks had propagated radially from the cap centre. Examination of this region by scanning electron microscope revealed regions of pronounced high local plasticity and many voids and micro-cracks in front of the tip of each crack (Figures 8 and 9).

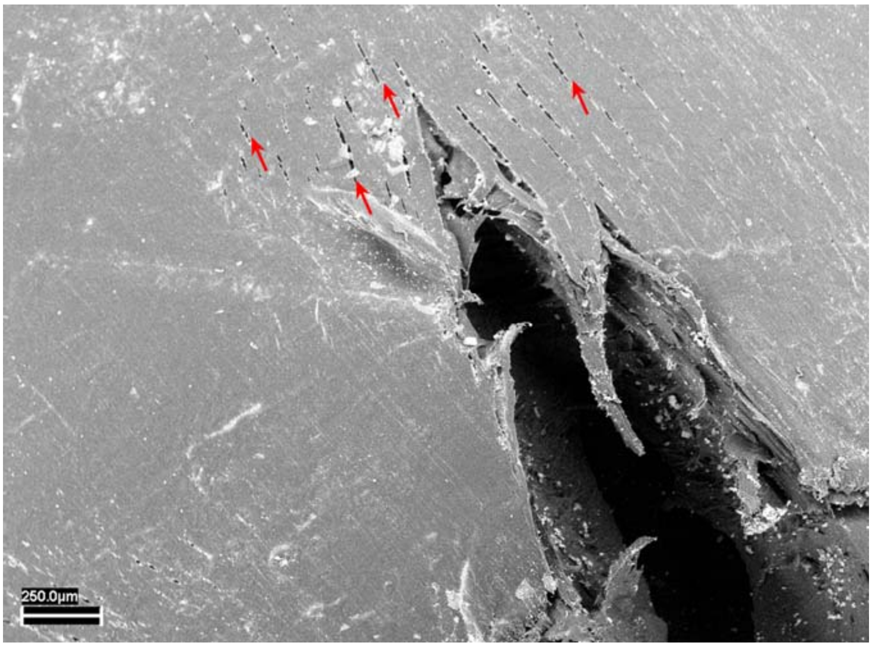
Examination of the cap's internal thread revealed scuffing and abrasion to the thread profile.

Figure 8: SEM image of the rupture site at the centre of the bulge.



Note: Arrow indicates intact membrane at end of cap.

Figure 9: High magnification SEM image of the rupture site.



Note: Arrows indicate voids, in front of the tip of a crack, that were produced by internal overpressure of the cap.

Plastic blanking cap pressure testing

The Australian Transport Safety Bureau (ATSB) tested the plastic blanking cap to determine if it would have been able to contain a pressure equivalent to that of the engine's un-metered fuel pressure at room temperature. The same test was also performed on a new, unused blanking cap of the same type.

The blanking cap from HYY was found to contain a pressure of up to 40 Psi without leaking (Figure 10). The new plastic cap contained a pressure of 60 Psi.

Figure 10: Pressure testing of the red plastic blanking cap from the accident site, with the gauge reading inset.

Hard/overweight landing

On 14 October 2006, HYY was damaged by a hard landing and propeller strike. The Cirrus SR22 *Aircraft Maintenance Manual* detailed a *Hard/Overweight Landing Check.* The check required examination of the fuselage rear floor structure in the area of the wing attach points, the landing gear assemblies, and parts of the wing. The check did not include inspection of the CAPS parachute area or its components. In addition, Civil Aviation Safety Authority (CASA) AD/ENG/6 Amdt 1[11] required examination of the engine following a propeller strike.

The aircraft was taken to a maintenance facility at Bankstown Airport, where the aircraft's owner assisted with the removal of the engine. This maintenance facility (the 'first maintenance facility') took the engine to a CASA-approved engine overhaul facility for disassembly, inspection and re-assembly of the engine (the 'second maintenance facility').

11 CASA AD/ENG/6 Amdt 1, Propeller Strike, required that, following a propeller strike, all piston engines be removed from service and disassembled, inspected, assembled and tested in accordance with the engine manufacturer's requirements.

After the engine had been disassembled at the second maintenance facility, CASA withdrew that facility's approval to overhaul engines. The dismantled engine was then transferred to another CASA-approved maintenance facility to complete the work (the 'third maintenance facility'). At that facility, the engine was examined and re-assembled. During a subsequent test-run of the engine, the requirements of Teledyne Continental Motors TCM SID 97-3C were carried out.

Engine blanking procedures

The third maintenance facility had standard operating procedures requiring the fitting of blanking caps, blanking plates, and blanking covers onto engines and components.

Personnel at the third maintenance facility recounted that, as required by their procedures, they did use such blanking devices to prevent the ingress of foreign material into engines. They considered it likely that, during the maintenance they performed on the engine, they would have fitted several red plastic caps of the same type as that found on the ground beneath HYY. These red plastic caps would have covered fittings including the un-metered fuel pressure test port T-fitting.

The engine manufacturer advised the ATSB that the steel cap (Part number - 639494) was an integral part of the engine and that it would not normally be removed during removal and installation of the engine. The cap could be removed during fuel system verification, then replaced once verification was complete. The engine manufacturer also advised that there were no instances where an unapproved plastic blanking cap should be used to replace the approved steel cap.

The aircraft owner reported that the steel cap was observed to be in situ on the engine when it had been removed from the aircraft for strip and examination, and it should have been returned with the serviceable engine following the re-build.

Engine re-installation

The re-assembled engine was returned to the first maintenance facility, where it was re-installed into HYY.

The re-installation of the engine was checked by a qualified licensed aircraft maintenance engineer. This included a test to check the fuel system for leaks, after which it was started and engine functional checks conducted.

The aircraft was subsequently taxied for some distance, during which engine performance was reported to be normal. It was then test-flown, after which the pilot reported that it flew well and the engine performed better than it had previously.

It was reported to the ATSB that the requirements of TCM SID 97-3 had not been carried out, as required by the Cirrus SR22 *Aircraft Maintenance Manual*, following engine re-installation. No new inspection lacquer had been applied to any of the engine fittings during the engine re-installation.

The Cirrus SR22 *Aircraft Maintenance Manual* included a section on standard practices[12] to be observed when carrying out maintenance on the aircraft. Paragraph 20-40, 2.B stated:

> Torque Seal should be applied to all jam nuts. Inspect torque sealed components whenever accessible and during each specified inspection period. Inspect the component for any signs of loosening. If the torque seal is broken, the component must be immediately inspected and serviced.

Discussions between ATSB investigators and several other maintenance organisations indicated that it was those organisations' practice to apply Torque Seal™ inspection lacquer on engine components such as the joint between the steel cap and the fuel pressure test port T-fitting.

Teledyne Continental Motors aircraft engine Service Information Directive SID 97-3

TCM SID 97-3 detailed the procedures and specifications for the adjustment of TCM continuous flow fuel injection systems, including the type fitted to HYY. The compliance section indicated that the requirements of SID 97-3 were to be carried out:

> At Engine Installation, 100 hour/Annual Inspection, fuel system component replacement or as required if operation is not within specifications.

The general information in the SID indicated:

> Fuel injection system components manufactured by TCM are adjusted and calibrated to meet engineering specifications. This ensures operation within those specifications throughout the full range of operation. Fuel injection system components installed on factory new and rebuilt engines are further adjusted to meet design specifications during operation in the production engine test facility. These tests and adjustments are carried out in an environment of controlled fuel supply pressures and calibrated test equipment.
>
> When engines are installed in aircraft, they are subjected to a different induction system, fuel supply system and operating environment. These differences require checking and adjusting the fuel injection system to meet operational specifications before flight…
>
> Operational verification of the engine fuel system is required any time one of the following circumstances occurs: (1) at engine installation, (2) during 100 hour and annual inspection…

In reference to the completion of engine maintenance, the SID stated in part:

> Remove the engine cowling or cooling shroud in accordance with the aircraft manufacturer's instructions. (a) remove all test gauges, fittings and hoses that were installed for fuel system setup, (b) reconnect all fuel hoses to their original locations, (c) support and torque all fittings to the specified value, see TABLE 1.

12 Cirrus SR22 *Aircraft Maintenance Manual*, Section 20-00, Standard Practices – Airframe.

Table 1 provided the torque specifications for hose-end fittings on the engine of the same size as the steel cap, however, the torque requirement for the steel cap was not specifically mentioned in this table.

Pre-flight Inspection

The Cirrus *Pilot's Operating Handbook* (POH) described the procedure for a pilot to carry out a pre-flight inspection on the SR22 aircraft type.

The pre-flight inspection procedure required that a pilot open the inspection door in the upper right side of the top engine cowl to check the quantity of the engine oil and the security of the oil cap. The security of the cowling attachment was also checked. There was no requirement for the pilot to view the area of the engine fuel system T-fitting during the pre-flight inspection.

Cirrus airframe parachute system

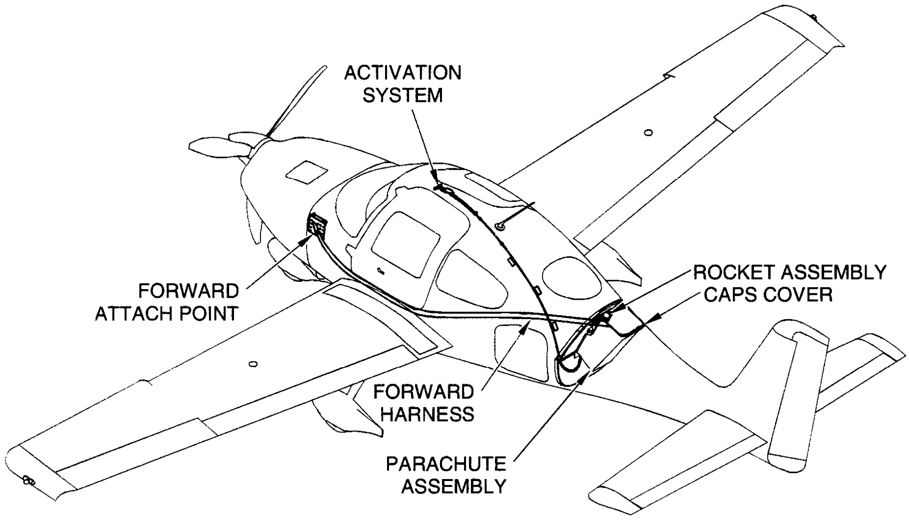
The aircraft was fitted with a Cirrus Airframe Parachute System (CAPS) designed to recover the aircraft and its occupants to the ground in the event of an in-flight emergency.

The CAPS comprised:

- a parachute (within a deployment bag) located within a fibreglass CAPS enclosure compartment;
- a solid-propellant rocket contained within a launch tube to deploy the parachute;
- a pick-up collar assembly and attached Teflon-coated steel cable lanyard and incremental bridle;
- a rocket activation system that consisted of an activation handle, an activation cable, and a rocket igniter; and
- a three-point harness assembly which attached the parachute to the fuselage.

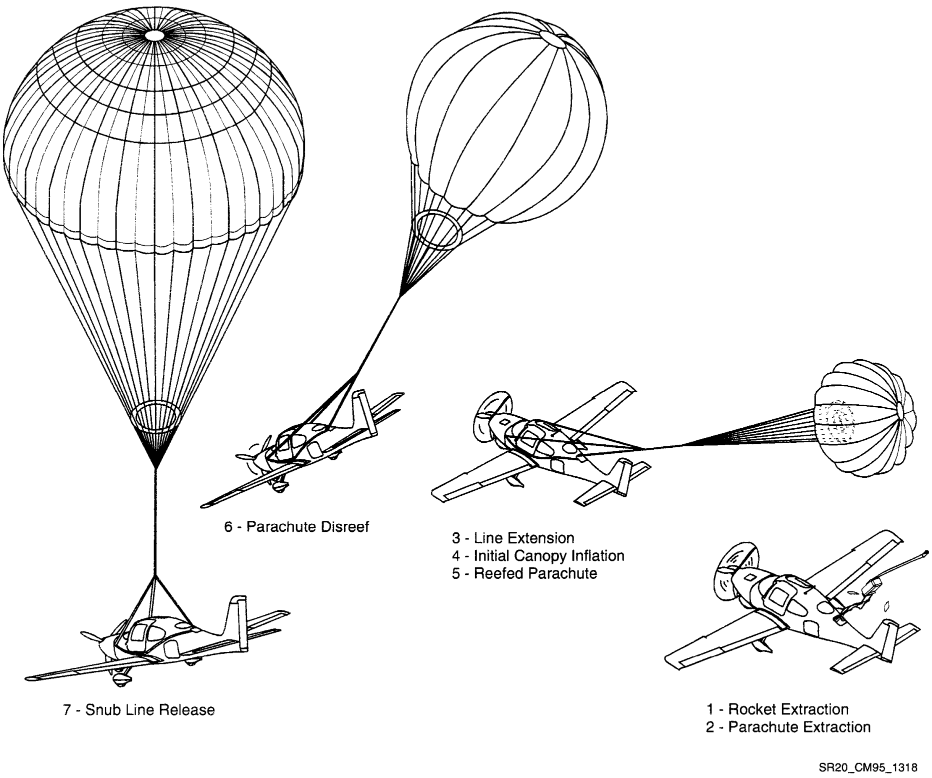
The two forward harness attachment points were connected to the parachute by separate forward webbing harnesses imbedded within the aircraft's skin. The rear harness assembly was attached to an aluminium cross-member attached to the rear of the baggage compartment bulkhead (Figure 11).

Figure 11: CAPS component position diagram



The CAPS was designed to activate when an aircraft occupant pulled a red T-handle mounted on the cockpit ceiling, firing the solid-propellant rocket, dislodging the fibreglass CAPS cover, and deploying the parachute (Figure 12). The solid-propellant rocket installed in Cirrus aircraft accelerates to approximately 250 km/h as it exits the fuselage and burns completely in 1.2 seconds.

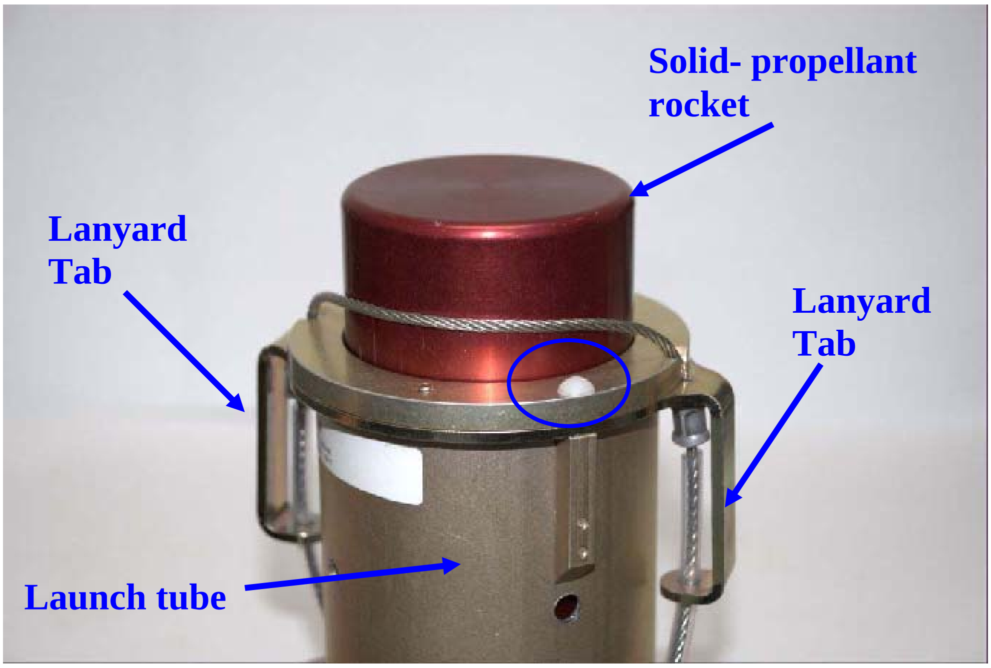
Figure 12: CAPS activation sequence



CAPS rocket and collar

The CAPS solid-propellant rocket was located inside a steel launch tube attached to a cross beam on the airframe. A pick-up collar assembly, consisting of a steel pick-up collar with integral lanyard tabs and an alloy pick-up collar support, was attached to the top of the launch tube by two nylon tension screws that held the collar in the correct position relative to the rocket (Figure 13). These screws were designed to shear on rocket activation when the raised rim around the base of the rocket contacted the pick-up collar assembly.

Figure 13: Pick-up collar and pick-up collar support correctly positioned on launch tube; showing nylon tension screws (circled)



CAPS deployment on HYY

The pilot informed ATC of his intention to deploy the CAPS parachute, after which no further calls were received from the aircraft.

Witness information was consistent with the pilot attempting to deploy the parachute at an estimated height of 90 to 120 ft AGL during final approach to the forced landing. The passenger recalled that the pilot pulled the CAPS deployment handle just prior to impact.

A warning in the Emergency Procedures section of the POH stated:

> CAPS deployment is expected to result in loss of the airframe and, depending upon adverse external factors such as high deployment speed, low altitude, rough terrain or high wind conditions, may result in severe injury or death to the occupants. Because of this, CAPS should only be activated when any other means of handling the emergency would not protect the occupants from serious injury.

The POH Emergency Procedures section, under the heading ‘Airspeed’ stated that the maximum CAPS deployment airspeed was 133 kts.

The POH described the CAPS 'Deployment Altitude', as follows:

> No minimum altitude for deployment has been set. This is because the actual altitude loss during a particular deployment depends upon the airplane's airspeed, altitude and attitude at deployment as well as other environmental factors. In all cases, however, the chances of a successful deployment increase with altitude. As a guideline, the demonstrated altitude loss from entry into a one-turn spin until under a stabilised parachute is 920 feet. Altitude loss from level flight deployments has been demonstrated at less than 400 feet. With these numbers in mind it might be useful to keep 2,000 feet AGL in mind as a cut-off decision altitude. Above 2,000 feet, there would normally be time to systematically assess and address the aircraft emergency. Below 2,000 feet, the decision to activate the CAPS has to come almost immediately in order to maximise the possibility of successful deployment. At any altitude, once the CAPS is determined to be the only alternative available for saving the aircraft occupants, deploy the system without delay.

Examination of CAPS components

Examination of the CAPS on HYY showed that when the rocket activated, it tangled the lanyard and incremental bridle around the empennage and the parachute did not deploy.

Witness marks on the fuselage showed that, rather than moving away from the aircraft as intended, the rocket passed downwards over the right side of the fuselage and became entangled around the empennage (Figures 14 and 15).

The rocket burnt out beneath the left elevator and left side of the vertical stabiliser. Heat damage marks from the rocket exhaust were evident on the side of the empennage, indicating that the elevators were in the full up position when the marks were made (Figure 16).

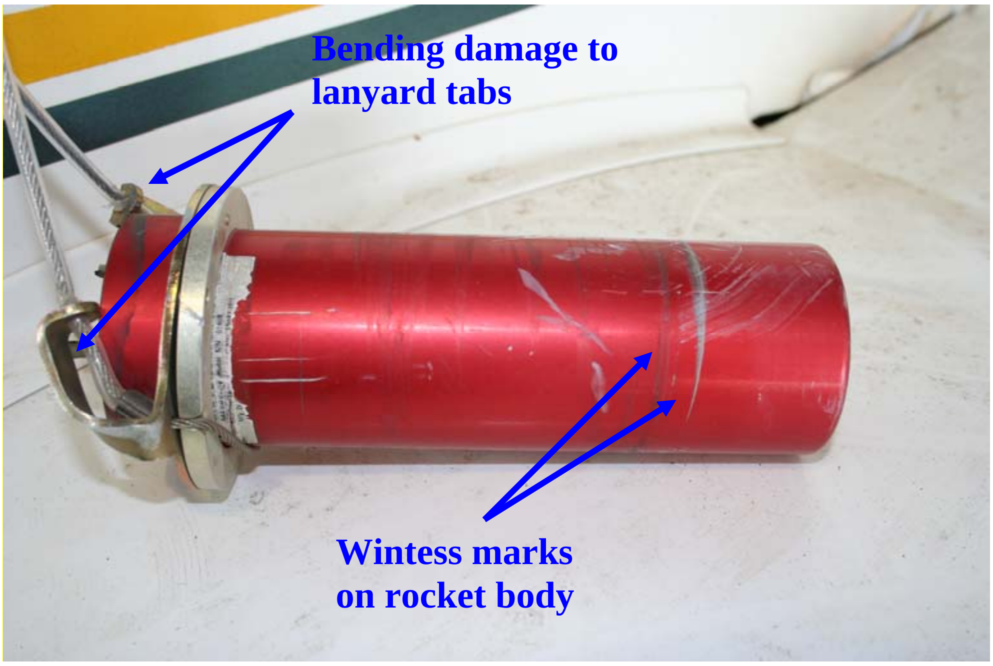
Damage and marks on the rocket body were consistent with the pick-up collar assembly and cable having prevented the rocket from exiting the launch tube cleanly. Bending of the pick-up collar lanyard tabs was consistent with the rocket having pulled unevenly on the parachute lanyard during deployment (Figure 17).

Figure 14: Path travelled by the CAPS rocket and harness

Figure 15: Path travelled by the CAPS rocket and harness

Figure 16: Burnt paint (circled) on lower surface of left elevator

Figure 17: Rocket and pick-up collar from VH-HYY



Nylon tension screw failure

The ATSB examined the two nylon tension screws retaining the pick-up collar assembly onto the rocket launch tube (Figure 18). The fracture surface of one (screw A) was conical in shape, exhibiting multiple interlacing fracture planes arranged in a somewhat spiral fashion (Figure 19). The other (screw B) showed a single dominant fracture plane at a shallow angle across the screw (Figure 20).

Both fractures appeared consistent with the screws having been overloaded. There may have been some torsional overload on the conically fractured screw (screw A).

Figure 18: Comparison between the two fractured nylon tension screws

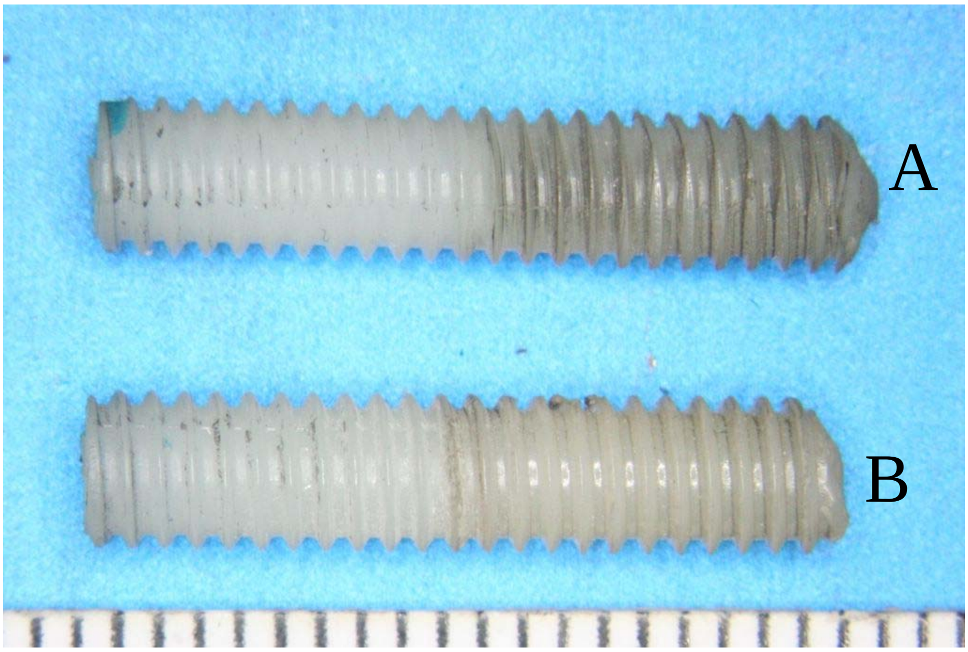


Figure 19: Conical fracture surface of nylon tension screw A

Figure 20: Fracture surface of nylon tension screw B

Examination of CAPS components by the aircraft manufacturer

The aircraft manufacturer examined several key components from HYY's CAPS, including the solid-propellant rocket, the pick-up collar, the Teflon-coated steel cable lanyard and incremental bridle, and others. All components were found to be compliant with the manufacturer's specifications.

Testing of the CAPS in the USA

On 16 March 2007, the aircraft manufacturer and the designer and manufacturer[13] of the CAPS, conducted a series of remotely-activated test extractions of the solid-propellant rocket and parachute assembly. These tests used current production CAPS components, including a packed parachute, housed in a mock-up fuselage. Each extraction sequence was recorded using high-speed digital video.

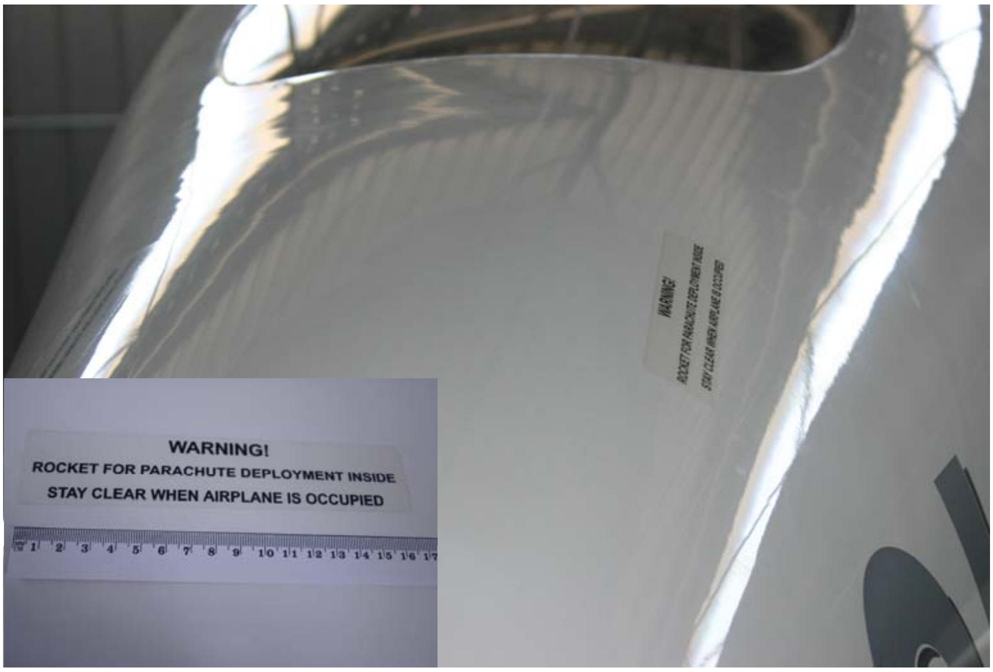
Each test resulted in a successful parachute extraction, although the digital video revealed that the pick-up collar assembly was moving prematurely from its attachment on the top of the launch tube. The manufacturer considered that the premature movement had the potential to adversely affect the trajectory of the rocket during deployment.

13 Ballistic Recovery Systems, Saint Paul, Minnesota USA.

CAPS warning placards and actions of emergency services personnel

CAPS warning placards on HYY were positioned on each side of the fuselage on top of the fibreglass CAPS cover (Figure 21). No external fuselage CAPS warning placards remained after the cover had been jettisoned during CAPS activation.

Figure 21: Typical fuselage CAPS warning placards



Some of the emergency services personnel who attended the aircraft accident had no prior knowledge of the CAPS and the potential dangers it posed. The ATSB warned the attending police site controller of the existence and potential danger of the CAPS. Following consultation with the ATSB and an aircraft manufacturer's representative, emergency service personnel subsequently cut through the roof of HYY to remove the injured occupants. The CAPS activation cable was stretched tight as a result of cutting through the roof and folding it back onto the rear fuselage (Figure 22).

The aircraft manufacturer produced a safety information DVD[14] that was targeted at first responders such as the police and emergency services personnel. The

14 In 2004, the aircraft manufacturer produced a CAPS Advisory DVD for First Responders. That DVD was used in accident safety training courses and presentations as a safety training

persons responding to this accident had not previously been made aware of the DVD.

The safety information included advice on the hazards posed by the CAPS and other safety equipment on board the Cirrus aircraft and indicated

> Never cut into the top of the aircraft…if the [CAPS] cable is pulled or dislodged more that ¼” by cutters or penetrating gear, the pull of the cable could set off the rocket igniter and set off the rocket.

The ATSB and the Directorate of Defence Aviation and Air Force Safety (DDAAFS) have jointly produced a safety information handbook[15] targeted at police officers and emergency services personnel. This handbook has been widely distributed in Australia and contains precautions about the CAPS and related systems.

Figure 22: CAPS activation cable stretched tight on roof of aircraft.

aid. Over 1,000 first edition DVD's were distributed worldwide. In 2007, a second edition of the DVD was developed which provided additional safety training information on CAPS, it also added safety training information on the new AmSafe Airbag Seatbelts, and electrical and fuel shut-off procedures. At the time of writing this report over 3,500 second edition DVD's have been distributed worldwide by the aircraft’s manufacturer in 2008 alone.

15 Civil and Military Aircraft Accident Procedures for Police Officers and emergency services Personnel, Edition 4, June 2006. The handbook can be viewed on the ATSB website at http://www.atsb.gov.au/publications/2006/cil_mil.aspx.

ANALYSIS

The engine of VH-HYY (HYY) lost power in flight. While attempting a forced landing, the pilot activated the Cirrus Airframe Parachute System (CAPS). The igniter and rocket fired normally, however, the trajectory took an abnormal path. The malfunction of the CAPS may have caused the aircraft to deviate from the pilot's intended flight path, because the rocket and deployment harness became entangled around the aircraft's tailplane and its flight control surfaces.

Engine power loss

The steel cap intended to seal the test port on the engine's fuel injection system T-fitting was not found at the accident site.

The ATSB considered a range of possibilities to explain the engine power loss, including that the steel cap had been fitted to the engine, but had detached during flight. The tight cowling and baffling around the engine of HYY would have retained a loose object of the size of a steel blanking cap. In that case, it should have been located at the accident site.

A red plastic blanking cap was found at the accident site, beneath the aircraft's engine. The red plastic blanking cap was of a type used during the repair of the engine following the hard landing on 14 October 2006. The aircraft had flown 5.4 hours since re-installation of the engine. The Australian Transport Safety Bureau (ATSB) found physical evidence that the red plastic blanking cap had been screwed onto a flared fitting and had been subjected to pressure while on that fitting. The red plastic blanking cap was demonstrated to have the ability to seal the test port at normal system operating pressures at room temperature.

It is probable that the red plastic blanking cap was inadvertently left on the test port following re-installation of the engine into the aircraft. It is also likely that the temperature and vibration of the operating engine led to the detachment of the red plastic blanking cap from the test port during flight. As a consequence, fuel supply to the fuel control unit was interrupted and the engine stopped.

Engine maintenance

Procedures at the third maintenance facility required that blanking caps be fitted following maintenance to prevent contaminants entering engines. The facility's personnel indicated it was likely they would have done this in the case of HYY and that the engine would have been forwarded to the first maintenance facility with a red plastic cap fitted to the fuel injection system test port T-fitting instead of the manufacturer's approved steel cap.

Personnel from the first maintenance facility, where the engine had been re-installed, reported that they conducted a check of the fuel system for leaks and did not recall seeing a red plastic blanking cap fitted to the engine.

The ATSB was advised that TCM SID 97-3 had not been carried out as required by the Cirrus SR22 *Aircraft Maintenance Manual* following the re-installation of HYY's engine by the first maintenance facility. It is probable that, had SID 97-3 been carried out, the test equipment would have been connected to the un-metered test port and any anomalies, such as the fitment of a red plastic cap, would have been noticed.

It was the practice of the aircraft manufacturer and certain maintenance organisations to mark joints, such as that between the steel cap and T-fitting, with a Torque Seal™ inspection lacquer. An inspection lacquer mark would indicate that an item had been checked, and show if it had moved from its intended position.

Any anomaly, such as the presence of the wrong type of cap, would probably have been detected if an inspection lacquer mark had been applied to HYY's fuel injection system test port T-fitting during engine re-installation.

The investigation could not determine when the required steel cap had been removed from the engine's fuel injection system T-fitting.

The torque value for the steel cap was not specifically mentioned in TCM SID97-3.

CAPS deployment

The pilot activated the CAPS at an estimated height of 90 to 120 ft above ground level, well below the aircraft manufacturer's recommended decision altitude for successful parachute deployment. The rocket fired, however, the parachute did not deploy and the rocket became entangled in the aircraft's empennage.

It is possible that the entanglement of the rocket and deployment harness around the tailplane and flight controls may have affected the controllability of the aircraft at a critical time during the forced landing approach, resulting in the aircraft diverting from the intended flight path.

Witness marks on the upper part of the rocket were consistent with the pick-up collar having initially jammed on the upper part of the rocket casing. This had adversely affected the rocket's trajectory and prevented the parachute from being pulled out of its enclosure within the fuselage.

One of the nylon retaining screws which kept the pick-up collar in place on the rocket's launch tube was found to have damage consistent with excess torque having been applied. Such damage could have occurred during assembly or disassembly at some time prior to the accident flight and would have reduced the ability of the screw to maintain the pick-up collar alignment when the CAPS rocket was activated.

It was also possible that the heavy landing in October 2006 may have damaged one or both of the nylon retaining screws, thereby changing the alignment of the pick-up collar in relation to the rocket. Inspection of these components was not required during the aircraft manufacturer's *Hard/Overweight Landing Check.*

Subsequent testing by the aircraft and CAPS manufacturers found that the pick-up collar could move prematurely from the top of the rocket launch tube during activation. Such movement was considered to have the potential to adversely affect the rocket's trajectory. However, the trajectory of the rocket that was evident in this accident, was not able to be replicated.

CAPS warning placards and actions of emergency services personnel

There were no warning placards on the wreckage of HYY to alert emergency services personnel to the danger posed by the CAPS rocket within the fuselage. These warnings were on the fibreglass CAPS cover which had been jettisoned during the attempted deployment of the CAPS. Although in this case the CAPS cover was jettisoned as a result of system activation, it is possible that the cover could become dislodged without activation of the CAPS and with the system still armed.

Some of the emergency services personnel who attended the accident were initially not aware of the dangers posed by the CAPS and had not seen the *Cirrus Advisory Guide for First Responders* DVD or the Australian Transport Safety Bureau/ Directorate of Defence Aviation and Air Force Safety publication (Footnote 13). As a consequence, some of the emergency services personnel were unaware of the potential hazards posed by the CAPS when they first arrived at the accident site. Had they cut through the roof and folded it back onto the fuselage in an accident where the CAPS had not been previously activated, this could have fired the rocket.

FINDINGS

From the evidence available, the following findings are made with respect to the Cirrus SR22 engine power loss accident and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The aircraft's engine suddenly lost power at about 1,200 ft above ground level, while positioning to overfly the Prospect VFR approach point for Bankstown Airport.
- The flow of fuel to the engine fuel control unit ceased as a result of the loss of the blanking cap from the un-metered fuel test port.
- It is probable that a red plastic blanking cap was inadvertently left on the engine following re-installation of the engine instead of the manufacturer-approved steel cap.
- Service Information Directive SID 97-3 was not followed after the engine was re-installed into HYY.
- The pilot selected the motorway for a forced landing, before the aircraft turned and heavily impacted sloping ground.

Other safety factors

- The pilot deployed the CAPS at a height significantly lower than that required for successful parachute deployment.
- The CAPS malfunctioned and the parachute did not deploy. The rocket's trajectory resulted in it becoming entangled in the aircraft's tail plane and may have affected the controllability of the aircraft at a critical time during the forced landing approach, diverting the aircraft from the pilot's intended flight path. [*Safety Issue*]
- The engine manufacturer's service information directive TCM SID97-3 was applicable to all IO-550 series and a number of other TCM engines. TCM SID 97-3 did not describe in sufficient detail the fitting of the steel cap on the fuel injection systems of IO-550 series and other TCM engines. [*Safety Issue*]
- During the rescue of the aircraft occupants, emergency services personnel cut through and moved a section of the aircraft's cabin roof. In an accident in which the CAPS had not been activated, this could have discharged an unfired rocket. [*Safety Issue*]
- The location and dimensions of CAPS warning placards on Cirrus aircraft are not optimal as they can be lost with the separation of the CAPS cover. They may not alert those who attend an accident site to the dangers posed by an unactivated CAPS. [*Safety Issue*]

Other key findings

- The crashworthiness of the aircraft improved the occupants' chances of surviving the impact.
- Damage to the red plastic cap was consistent with the cap being in place on the engine while it was running.
- A search of the accident site failed to locate a steel cap.
- The aircraft manufacturer's *Hard/Overweight Landing Check* does not require examination of the CAPS and its mounting.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Action sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Safety issue

The CAPS malfunctioned and the parachute did not deploy. The rocket's trajectory resulted in it becoming entangled in the aircraft's tail plane and may have affected the controllability of the aircraft at a critical time during the forced landing approach, diverting the aircraft from the pilot's intended flight path.

Aircraft manufacturer safety action

On 2 April 2007, in response to the failure of the CAPS in VH-HYY, and subsequent testing in the USA, the aircraft manufacturer issued Cirrus Alert Service Bulletin, SB A2X-95-10, ATA 95-00: Special Equipment, CAPS Pick-up Collar Support Replacement (Appendix A). The Service Bulletin introduced a new CAPS pick-up collar support and aluminium tension screws (Figures 23 and 24).

Figure 23: New design aluminium tension screws (upper) compared to nylon type (lower)

Figure 24: New design pick-up collar; showing aluminium tension screw (circled)

Regulatory authority safety action

As a result of this accident, the United States Federal Aviation Administration (FAA) issued FAA AD 2007-14-03, dated 16 August 2007, mandating compliance with Cirrus Alert Service Bulletin SB A2X-95-10. The Australian Civil Aviation Safety Authority (CASA) subsequently issued Airworthiness Directive AD/CIRRUS/7, dated 30 August 2007, mandating the requirements of Cirrus Alert Service Bulletin SB A2X-95-10 for all Australian registered aircraft.

Similar Airworthiness Directives have been issued for Cessna 182 series aircraft (FAA AD 2008-02-18 and CASA AD/CESSNA 180/91) and Cessna 172 series aircraft (FAA AD 2008-02-18 and CASA AD/CESSNA 170/80). These mandate Service Bulletins raised by the Ballistic Recovery Systems (BRS SB 07-01 for Cessna 172s and BRS SB 07-02 for Cessna 182S).

Safety Issue

The engine manufacturer's service information directive Teledyne Continental Motors (TCM) SID97-3 was applicable to all IO-550 series and a number of other TCM engines. TCM SID 97-3 did not describe in sufficient detail the fitting of the steel cap on the fuel injection systems of IO-550 series and other TCM engines.

Engine manufacturer safety action

In response to a request from the ATSB regarding the inclusion of information about the steel cap in TCM SID 97-3, TCM indicated the following.

> TCM is currently in the process of revising Service Information Directive SID 97-3 (Revision. E) and [TCM] will submit language that specifically addresses the metal cap and its torque to be included with this revision.

Those changes were included in revision E to SID 97-3 that was issued on 17 June 2008. Changes were made in the Setup Procedures, Post Setup Procedures and at Table 1. The Post Setup Procedures included, in part, the following comment:

> ASSURE CAP ASSEMBLY 639494 IS CORRECTLY INSTALLED ON INLET TEE FITTING OF COMBINATION THROTTLE BODY/METERING UNITS. TORQUE TO 135-190 INCH POUNDS PER TABLE 1 SPECS. UNDER NO CIRCUMSTANCE ALLOW ANY CAP FITTING OTHER THAN 639494 TO BE INSTALLED DURING ENGINE OPERATION.

Safety issue

During the rescue of the aircraft's occupants, the emergency services personnel cut through the aircraft's cabin roof at several points that, in an accident where the CAPS had not been activated, could have resulted in the discharging of an unfired rocket.

Aircraft manufacturer safety action

The following response was received from the aircraft manufacturer in response to an ATSB question about perceived safety issues.

> Cirrus Design has, and continues to, expend considerable resources in an attempt to educate the first responder community. To date we estimate that we have put information regarding ballistic recovery systems into the hands of roughly 25,000 people. We maintain a full time position devoted entirely to this endeavor. In the last four years alone, [Cirrus's], Director of Air Safety Training, has spoken at 176 venues worldwide. [Cirrus] has also produced two safety DVDs. The first DVD solely addressed ballistic recovery systems and approximately 1000 were distributed. The second DVD was updated to include other aircraft hazards in addition to ballistic recovery systems. 3,500 of these DVDs were distributed this year alone. Cirrus Design asks in turn that all who have received our training pass on both the knowledge gained from our training and our availability to show up free of cost to organized groups in search of such training. This applies to government agencies, first responders, insurance agents, salvage operators, and anyone with a genuine need for the training.

Ambulance Service of NSW safety action

The following response was received in part for the Ambulance Service of NSW:

> The Service recognises this as an issue and will put forward an admin bulletin to our staff highlighting the Civil and Military Aircraft procedures for Police Officer and Emergency Services Personnel [handbook].

NSW Fire Brigades safety action

The following response was received in part from the New South Wales Fire Brigades (NSWFB) regarding this issue:

> In response to this safety issue, [The NSWFB] was aware that this aircraft had CAPS installed. [NSWFB] was aware that the CAPS had partially deployed and [NSWFB] was familiar with the dangers associated with ballistic parachute systems attached to light aircraft. [NSWFB] applied the NSWFB Safety Bulletin 2004/10 which heightens the awareness of NSWFB personnel when attending incidents involving light aircraft.

Safety Bulletin 2004/10 states, in part:

> Emergency personnel who move or cut aircraft wreckage without determining the existence of a ballistic parachute system, or who disregard the position of the rocket motor as they work with the wreckage risk death or serious injury.

Southern Region SLSA Helicopter Rescue Service comment

Following receipt of the draft report the Southern Region SLSA Helicopter Rescue Service commented that the ATSB should send a letter to the State Rescue Board (NSW) and their equivalents in other States and Territories notifying them of the hazards and ways to detect whether the rocket assisted system had activated.

They also indicated that the information could possibly also be forwarded to the various helicopter rescue organizations through the office of the Australian Maritime Safety Authority (AMSA).

Australian Transport Safety Bureau safety action

In order to alert the relevant State Emergency Service Authorities to the dangers posed to them by ballistic parachute systems in light aircraft, the ATSB will forward these authorities copies of this report and direct them to the safety information on the ATSB website contained in the document Civil and Military Aircraft Procedures for Police Officers and Emergency Services Personnel.

Safety issue

Cirrus Aircraft Parachute System (CAPS) Warning decals on the Cirrus aircraft do not sufficiently alert first responders and others who attend an accident site, of the significant dangers posed by an unused ballistic rocket system

Aircraft Manufacturer safety action

The following was received from the aircraft manufacturer in response to an ATSB question about perceived safety issues.

> The FAA is currently working on an Airworthiness Concern Sheet that will poll aircraft owners, industry, and the public regarding the placarding of aircraft outfitted with ballistic recovery systems. Cirrus Design intends to monitor and contribute to this process so that a consensus-based solution may be brought forth that is seen as reasonable by all parties regarding the placarding of ALL aircraft outfitted with ballistic systems. Cirrus represents less than 15% *of* the 26,000 units sold by BRS therefore we believe any recommendation should be an industry wide recommendation.

> Cirrus Design endeavors to improve the safety of its products as a whole. Our current placarding evolved from two placards to five based on operational experience and the suggestions of others. In the future, Cirrus Design intends to retro-fit its current placarding where possible to older fleet airplanes when the 10-year parachute repacking occurs.
>
> Additionally, as a result of the ATSB's investigation, it was noted that the warning placards for the subject airplane were on the parachute enclosure cover. When the CAPS fired; it effectively removed the external placards from the airplane by removal of the enclosure cover during the launch sequence. Keep in mind in this case the danger was removed therefore the need for placards was moot. Despite this, Cirrus Design is taking action to identify planes that may have this configuration and relocate the placards to the fuselage. This way regardless of the location of the parachute enclosure cover the exterior of the airplane will be placarded.

The following was received from Cirrus on 18 June 2008, as an update regarding CAPS placards:

> It should be noted, Cirrus Design has maintained that the training of first responders was and is the key to safety in accident response and we continue to implore government agencies to pursue this avenue to the fullest extent possible.
>
> In an earlier response to your agency, it was stated that we were working with our FAA regarding exterior placarding. Our response to the FAA is nearing completion. Included in the response are several proposed changes and enhancements regarding the size, shape, color, wording, material used and placement of exterior placards as called out by the ASTM[16] standard currently being used by the light sport industry.
>
> Included in the proposal are two placards. One will be placed near the pilot/passenger entry points. The "entry point" placard will be made of a highly visible, reflective material. The second will be placed on or near the CAPS Enclosure Cover. The "enclosure cover" placard will also use a highly visible, reflective material.
>
> In researching the issue of exterior placard placement on or off the parachute enclosure cover the following was noted. CAPS Rocket Motors produced in 2004 and subsequent have a placard affixed to their top. This placard will aid in the identification of the CAPS Rocket Motor in the event that the CAPS Enclosure Cover should become separated from the airplane.
>
> This placard will also aid in the identification of the CAPS Rocket Motor in the event that the CAPS Rocket Motor should become separated from its mounted position, or perhaps separated from the airplane.
>
> Additionally, it should be noted that this placard will also be present on all new rocket motors installed during the 10-year replacement.

NSW Rural Fire Service safety action

The following was received from the New South Wales Rural Fire Service regarding on-site dangers of rocket powered recovery parachute systems:

16 ASTM International, originally known as the American Society for Testing and Materials (ASTM).

> The Rural Fire Service currently provides training regarding the potential dangers of 'rocket powered recovery parachute systems' within our Crew leader Training Course since 2005.
>
> This module explains such systems as CAPS and the required precautions when approaching the airframe. It is noted within the training that there are 'warning labels' on the external surfaces of the aircraft but these markings come in a variety of shapes, sizes and locations and are not always clearly visible and may not always be recognised as potentially dangerous.
>
> Accordingly the Rural Fire Service supports the report's recommendations regarding standardising warning labels and ensuring that their location remains on the fuselage of the aircraft. This will assist first responders on assessing the risks when approaching and incident.
>
> The Service has also issued all Districts and Brigades in the State a copy of the ATSM handbook on Aircraft Accident Procedures for Emergency Services Personnel.

Previous ATSB Recommendations

As a result of concerns with accident-site safety due to the escalating number of aircraft flying in Australia with rocket-assisted parachutes and other similar devices, the ATSB has previously issued several safety recommendations relating to danger zone marking and accident investigation hazards with aircraft rocket assisted parachute systems. Those recommendations and their responses are reproduced below.

R20040094 issued to the International Civil Aviation Organisation on 27 Jan 2005:

> The Australian Transport Safety Bureau recommends that the International Civil Aviation Organisation develop an international standard for the marking of aircraft equipped with rocket-assisted recovery parachute systems to ensure that they fully alert persons to the hazards and the danger areas on the aircraft.

ICAO response dated 3 Aug 2005:

> An aircraft accident site can contain many hazards to the safety of personnel, some obvious and some not so obvious. ICAO agrees that in the event of an accident to an aircraft equipped with one of these devices, the armed and unfired rocket component of a ballistic parachute system poses a potential hazard to emergency and other personnel responding to the accident. However, ICAO is not convinced that developing an international standard for the marking of aircraft fitted with such devices is the best, or only way to address this issue.
>
> Although such devices have been installed in a limited number of normal category aircraft up to the size of a Cessna 182, the vast majority of ballistic parachutes are installed in sport, experimental, home-built or ultralight aircraft. This latter group of aircraft is not subject to the design and maintenance provisions of ICAO Annexes. Thus, the imposition of international standards on this increasingly large group of lightly regulated aircraft would not be possible and would not necessarily achieve the desired result.

> Certification requirements for the installation of ballistic parachutes, either as original equipment, or by supplemental type certificate, call for suitable placards to be displayed on the aircraft warning of the hazards of these devices. While the size and prominence of such warning placards may vary between manufacturers, international standards already exist for the design of warning placards. If ICAO were to develop an additional single international warning placard for such devices, the placard would have to recognize the different languages and cultures of ICAO Contracting States. Considering that the affected aircraft are not frequently, or routinely, involved in international aviation, this would be an excessive imposition. Such a process would also take considerable time to resolve.
>
> ICAO believes it would be more effective and timely for individual States, or groups of States, to ensure that such warning placards on aircraft in their State(s) are relevant, in terms of language and layout, and that all personnel that are likely to respond to emergencies involving such aircraft are familiar with the warnings and with the handling of the devices themselves.
>
> The ATSB recommendation highlights a potential problem as these devices are installed in increasing numbers of aircraft. Accordingly, ICAO intends to take several actions to address this emerging threat, as follows:
>
> a) advise States of the potential dangers of ballistic parachutes installed in aircraft and invite them to review the adequacy of the warning placards required for such devices and to ensure that emergency responders, such as police, ambulance, rescue/fire service and accident investigators, as well as maintenance personnel, are aware of the potential hazards posed by such devices and of the correct means to render such devices safe;
>
> b) include in the *Manual of Aircraft Accident Investigation (Doc 6920),* which is currently being rewritten, reference to the potential hazards of such devices, as well as guidance on appropriate safety precautions; and
>
> c) consider the development of an amendment proposal to Annex *8-Airworthiness of Aircraft* for consideration by the Air Navigation Commission by adding a broad provision requiring warning placards to draw attention to special hazards on aircraft.
>
> I trust that you agree that the course of action that ICAO intends to take with respect to this matter adequately addresses the intent of the safety recommendation.

ATSB recommendation status: Monitor

ATSB response to ICAO on 27 July 2006:

> In line with the ATSB policy of periodically reviewing these recommendations and as it has been about a year since your reply to this recommendation, can you please update the ATSB on what ICAO has done in respect to the commitments made?

Subsequent ICAO response to ATSB of 12 August 2006:

> I wish to refer to your e-mail addressed to [ICAO], dated 26 July 2006, concerning ICAO's response to Australian Transport Safety Board Recommendation R20040094.

In your e-mail you ask for an update on what ICAO has done in respect to the recommendations addressed to the Organization concerning markings of aircraft equipped with rocket-assisted recovery parachute systems. In a letter to the Australian Transport Safety Board, dated 3 August 2005, ICAO made the following commitments:

a) advise States of the potential dangers of ballistic parachutes installed in aircraft and invite them to review the adequacy of the warning placards required for such devices and to ensure that emergency responders, such as police, ambulance, rescue/fire service and accident investigators, as well as maintenance personnel, are aware of the potential hazards posed by such devices and of the correct means to render such devices safe;

b) include in the Manual of Aircraft Accident Investigation (Doc 6920), which is currently being rewritten, reference to the potential hazards of such devices, as well as guidance on appropriate safety precautions; and

c) consider the development of an amendment proposal to Annex 8 - Airworthiness of Aircraft for consideration by the Air Navigation Commission by adding a broad provision requiring warning placards to draw attention to special hazards on aircraft.

I am pleased to inform you that ICAO has completed items a) and b). State letter AN 6/26-05/46, dated 12 August 2005, was sent out warning States of the danger of rocket-assisted recovery parachute systems and information on such systems has been included in the Manual of Aircraft Accident and Incident Investigation and also in the Circular on Hazards at Accident Site. These documents are currently being revised for printing. However, item c) is being evaluated by ICAO. A proposal for warning placards was sent to the Airworthiness Panel for review. The panel is currently developing an amendment to Annex 8. This work is scheduled to be completed at the next meeting of the panel (AIRP/2) currently planned to be held in May 2007.

I trust this update is satisfactory. If you need additional information on this subject please do not hesitate to contact me.

ATSB recommendation status: Monitor

Subsequent ICAO response of 10 January 2007:

I wish to refer to the e-mail I sent you on 11 August 2006 concerning ICAO's response to Australian Transport Safety Board Recommendation (R20040094). In the e-mail, I provided an update on ICAO's action in respect to recommendations addressed to the Organization concerning markings of aircraft equipped with rocket-assisted recovery parachute systems, as follows:

a) advise States of the potential dangers of ballistic parachutes installed in aircraft and invite them to review the adequacy of the warning placards required for such devices and to ensure that emergency responders, such as police, ambulance, rescue/fire service and accident investigators, as well as maintenance personnel, are aware of the potential hazards posed by such devices and of the correct means to render such devices safe;

b) include in the Manual of Aircraft Accident Investigation (Doc 6920), which is currently being rewritten, reference to the potential hazards of such devices, as well as guidance on appropriate safety precautions; and

c) consider the development of an amendment proposal to Annex 8 - *Airworthiness of Aircraft* for consideration by the Air Navigation Commission by adding a broad provision requiring warning placards to draw attention to special hazards on aircraft.

At the time, ICAO had completed items a) and b). However, item c) was scheduled to be reviewed by ICAO's Airworthiness Panel (AIRP) during its meeting in May 2007. I am pleased to inform you that the Panel was able to expedite its work on the subject and complete the review.

During the review, the Panel concluded that requiring warning placards for aircraft equipped with rocket-assisted recovery parachute systems would not increase safety at accident sites. Warning placards may not be visible in some conditions such as during low visibility and it is also believed that personnel close enough to read the placards are already inside the danger zone of the equipment.

I trust this decision meets with your satisfaction. If you need additional information on this subject please do not hesitate to contact me.

ATSB recommendation status: Closed/Partially Accepted

R20040095 issued to the Federal Aviation Administration on 27 Jan 2005:

The Australian Transport Safety Bureau recommends that as a priority the US Federal Aviation Administration liaise with the European Aviation Safety Agency and the International Civil Aviation Organisation to develop an international standard for the marking on all aircraft equipped with rocket-assisted recovery parachute systems to ensure that they fully alert persons to the hazards and the danger areas on the aircraft.

ATSB recommendation status: **No response received**

R20040096 issued to the European Aviation Safety Agency on 27 Jan 2005:

The Australian Transport Safety Bureau recommends that as a priority the European Aviation Safety Agency liaise with the US Federal Aviation Administration and the International Civil Aviation Organisation to develop an international standard for the marking on all aircraft equipped with rocket-assisted recovery parachute systems to ensure that they fully alert persons to the hazards and the danger areas on the aircraft.

EASA response dated 13 Feb 2007:

The EASA has addressed this concern to ICAO. No specific action is for the time being planned on the marking of aircrafts but ICAO is right now considering to include guidance material in the new Manual of Aircraft Accident and Incident Investigation on this subject.

ATSB recommendation status: Closed/Partially Accepted

R20040097 issued to the Civil Aviation Safety Authority on 27 Jan 2005:

> The Australian Transport Safety Bureau recommends that the Australian Civil Aviation Safety Authority publish guidance alerting all personnel who would normally attend an accident site to the dangers associated with aircraft equipped with rocket-assisted recovery parachute systems.

CASA response dated 19 May 2005:

> Thank you for providing the Civil Aviation Safety Authority (CASA) with a copy of Air Safety Recommendation R20040097 in relation to light aircraft rocket-assisted recovery parachute systems.
>
> In response to recommendation R20040097, I am advised that in addition to its earlier advice, CASA is currently reviewing the ATSB's recommendation to publish guidance material on this issue.
>
> However, I understand that a project involving a number of areas within CASA would need to be undertaken before a commitment to produce any guidance material can be provided. Additionally, I am advised that due to the number of activities currently being undertaken by CASA, work on this project may not commence until July 2005.
>
> In the interim, it should be noted that CASA's aerodrome inspectors have communicated their concerns regarding these devices to aerodrome operators who are able to bring this issue to the attention of their Aerodrome Emergency Committee. Safety information from BRS Inc, one of the manufacturer's of the recovery parachute systems, was also provided to operators for their consideration.
>
> I am advised that CASA also passed information on to the Aerodrome Rescue and Fire-Fighting Service (ARFFS), who I understand have now included material dedicated to these devices in their training manual.

ATSB recommendation status: Monitor

CASA subsequent response to ATSB of 8 Sep 2006

> I refer to your e-mail dated 27 July 2006 requesting an update on the response by the Civil Aviation Safety Authority (CASA) to the Australian Transport Safety Bureau's (ATSB) Air Safety Recommendation R20040097 in relation to light aircraft rocket assisted parachute recovery systems. I apologise for the delay in responding.
>
> CASA is considering the issues relating to appropriate warning markings on aircraft carrying this type of equipment, especially in the absence of an agreed international standard. A decision has yet to be made as to whether advising the aviation community of the potential hazards should be done through a Civil Aviation Advisory Publication or through drawing their attention to safety resources produced by the manufacturer. In considering these issues CASA must also take into account the fact that it has a limited regulatory role after accidents and has already taken a number of steps to alert Aerodrome Rescue and Fire Fighting Services of this problem, as advised in CASA's letter to the ATSB of 19 May 2005.

ATSB recommendation status: Closed – Partially Accepted

APPENDIX A: CIRRUS ALERT SERVICE BULLETIN, SB A2X-95-10

CIRRUS

Alert Service Bulletin

SB A2X-95-10

Issued: 02 Apr 2007

Models SR20 and SR22

ATA 95-00: Special Equipment
CAPS Pick-up Collar Support Replacement

COMPLIANCE

Mandatory: Cirrus Design considers this Service Bulletin to be MANDATORY. Accomplish this Service Bulletin within the next 25 flight hours or 60 days, whichever occurs first. Compliance time begins upon the date of issue.

CAUTION: This Service Bulletin may only be accomplished by a Cirrus Design trained and authorized parachute system technician. Airframe and Powerplant license is not sufficient credential for performing this Service Bulletin.

EFFECTIVITY

Cirrus Design SR20 serial numbers 1005 thru 1798.

Cirrus Design SR22 serial numbers 0002 thru 2437.

APPROVAL

FAA approval has been obtained on all technical data in this Service Bulletin that affects type design.

PURPOSE

Some airplanes may exhibit a condition where upon CAPS activation, the pick-up collar assembly may prematurely move off the launch tube and adversely affect rocket trajectory during deployment. This Service Bulletin will correct this condition by installation of a new pick-up collar support and custom tension screws.

DESCRIPTION

This Service Bulletin provides for the replacement of the pick-up collar support and screws.

WARRANTY INFORMATION

Cirrus Design will cover parts and labor costs for this Service Bulletin if the work is accomplished within the compliance period and the work is accomplished at an authorized Cirrus Design Service Center. The Warranty Claim Form must be properly filled out and submitted to Cirrus Design in order to obtain a warranty credit.

MANPOWER REQUIREMENTS

Serials SR20-1005 thru 1422, SR22-0002 thru 0820: 1.5 manhours.

Serials SR20-1423 thru 1624, SR22-0821 thru 1840: 1.25 manhours.

Serials SR20-1625 thru 1798, Serials SR22-1841 thru 2437: 1.5 manhours.

Cirrus Design Corporation
4515 Taylor Circle
Duluth, Minnesota 55811
PH (218) 788-3000

Cirrus Design Corporation cannot be responsible for the quality of work performed by others while fulfilling the requirements of this service bulletin. Procedures specified in this service bulletin must be accomplished using industry standard maintenance practices and applicable government regulations.

OTHER PUBLICATIONS AFFECTED

N/A

WEIGHT AND BALANCE

N/A

MATERIAL INFORMATION

The following parts are required to comply with this Service Bulletin. Parts can be obtained from an Authorized Cirrus Design Service Center or Parts Distributor.

Order kit 70181-001 to obtain the following parts.

Item No.	Description	P/N or Spec.	Supplier	Quantity
1	Pick-up Collar Support	18748-001	Cirrus Design	1
2	Screws, Aluminum	21914-001	Cirrus Design	2

ACCOMPLISHMENT INSTRUCTIONS

Note: The configuration of the CAPS installation varies across three distinct serial ranges of aircraft. Prior to performing this Service Bulletin, mark those steps applicable only to the serial number of the aircraft you are working on using a highlighting marker. Additional copies of this publication may be found on the Cirrus Technical Publication website at: http://service-centers.cirrusdesign.com/techpubs/

A. Acquire necessary tools, equipment, and supplies.

Description	P/N or Spec.	Supplier	Purpose
Threadlock	Loctite 242	Any Source	Bond screws.
Vacuum Cleaner	-	Any Source	Cleaning.

B. Remove key from ignition.

C. Set BAT 1, BAT 2, and AVIONICS switches to OFF positions.

CAUTION: Ensure hands are clean while working with interior trim components.

D. Remove CAPS handle access cover and install CAPS handle safety pin. (Refer to CMM 95-00)

E. Remove BH 222 trim panel and carpet. (Refer to AMM 25-10)

F. Remove access panels CB7 from BH 222. (Refer to AMM 6-00)

G. To prevent debris and components from falling into bottom of empennage, place catch cloth below rocket and parachute assembly.

WARNING: **Activation of rocket igniter requires 25 lb (11.25 kg) pull force. Use caution during removal, modification, and installation procedures to not introduce any unnecessary pulling force on the activation cable.**

Always position rocket in a safe direction while handling the CAPS rocket assembly.

Due to differing tolerances between the rocket assembly shelves, quantities of shims/washers may differ from those depicted in the figures.Ensure the exact stackup of the attaching hardware is noted during disassembly and then replicated during reassembly. Failure to do so may result in an incorrect rocket installation and subsequent deployment failure.

H. *Serials SR20-1005 thru 1422, Serials SR22-0002 thru 0820:* Perform Procedure - CAPS Rocket Assembly Removal. (See Figure 01)

1. While supporting rocket assembly, remove bolts and washers securing shim, backing plate, and rocket motor assembly to BH 222.

CAUTION: Do not snag rocket assembly on parachute or surrounding structure while removing.

2. To facilitate rocket assembly removal, move CAPS harness to either side and carefully pull spiral wrap cable from adjustable bushing pass-through hole as required.
3. Carefully slide rocket assembly from behind BH 222 so that top of rocket assembly is exposed.

I. *Serials SR20-1423 thru 1624, Serials SR22-0821 thru 1840:* Perform Procedure - CAPS Rocket Assembly Removal. (See Figure 02)

1. Remove bolts, washers, and nuts securing rocket assembly bracket to BH 222 cross beam.
2. Remove bolts and washers securing cross beam to BH 222.
3. While supporting rocket assembly, remove bolts and washers securing rocket motor assembly to CAPS compartment.

CAUTION: Do not snag rocket assembly on parachute or surrounding structure while removing.

4. To facilitate rocket assembly removal, move CAPS harness to either side and carefully pull spiral wrap cable from adjustable bushing pass-through hole as required.
5. Carefully slide rocket assembly from behind BH 222 so that top of rocket assembly is exposed.

J. *Serials SR20-1625 thru 1798, Serials SR22-1841 thru 2437:* Perform Procedure - CAPS Rocket Assembly Removal. (See Figure 03)

1. While supporting rocket assembly, remove bolts and washers securing rocket assembly to BH 222 cross beam.
2. Remove bolts and washers securing cross beam to BH 222.

CAUTION: Do not snag rocket assembly on parachute or surrounding structure while removing.

3. To facilitate rocket assembly removal, move CAPS harness to either side and carefully pull spiral wrap cable from adjustable bushing pass-through hole as required.
4. Carefully slide rocket assembly from behind BH 222 so that top of rocket assembly is exposed.

K. Perform Procedure - CAPS Rocket Assembly Modification. (See Figure 04)

1. Remove and discard nylon tension screws securing pick-up collar assembly to rocket launch tube.
2. Slide pick-up collar assembly off of rocket to facilitate removal of rocket lanyard from retaining grooves.
3. Remove screws securing existing pick-up collar support to pick-up collar.
4. Press retaining groove on pick-up collar support toward the rocket lanyard. Use fingers to pry rocket lanyard from opposite retaining groove and pivot the pick-up collar support until lanyard is disengaged from retaining grooves.
5. Discard existing pick-up collar support.
6. Inspect inner diameter of pick-up collar for surface irregularities (bump). If any bumps exist:
   a. Acquire necessary tools, equipment, and supplies.

Description	P/N or Spec.	Supplier	Purpose
Half-Round File	-	Any Source	
Isopropyl Alcohol	TT-I-735 Grade A or B	Any Source	Clean installation area.
Cotton Cloth (clean and lint free)	-	Any Source	Clean installation area.
Primer	(Refer to AMM 51-30)	Any Source	Seal.

   b. Use half-round file as required to remove bumps.
   c. Solvent clean with isopropyl alcohol. (Refer to AMM 20-30)
   d. Apply primer to affected area.

WARNING: Position rocket lanyard around top outside diameter of pick-up collar support, NOT over top of the rocket. Failure to comply will absolutely FAIL rocket deployment!

7. Position replacement pick-up collar support to upper side of pick-up collar.
8. Position retaining groove of pick-up collar support to rocket lanyard. Pivot pick-up collar support until the rocket lanyard engages the opposite retaining groove.
9. Apply threadlock to screws removed previously from pick-up collar.
10. Install screws securing pick-up collar support to pick-up collar.
11. Slide pick-up collar assembly onto rocket.
12. Verify pick-up collar assembly slides freely on rocket.
13. Verify anchor blocks are perpendicular to pick-up collar assembly. If pick-up collar assembly is not fully seated against the anchor blocks, use pliers to gently adjust anchor blocks as required.
14. Apply threadlock to aluminum tension screws.

CAUTION: Do not overtighten aluminum tension screws.

15. Install aluminum tension screws securing pick-up collar assembly to rocket launch tube using nut driver. Tighten aluminum tension screws until snug.

L. *Serials SR20-1005 thru 1422, Serials SR22-0002 thru 0820:* Perform Procedure - CAPS Rocket Assembly Installation. (See Figure 01)

CAUTION: Ensure the exact stackup of the attaching hardware, noted during disassembly, is replicated during reassembly.

1. At the top of the parachute assembly, locate and feed the lanyard aft, towards the stowage pocket in the parachute assembly, to facilitate recoiling.

   CAUTION: Do not snag rocket assembly on parachute or surrounding structure while installing.

2. Position rocket motor assembly, shim, and backing plate to BH 222. Install bolts and washers.
3. Verify activation cable is routed through shield slot and secured with cable grommet.

   WARNING: Incorrect gap between outer diameter of pick-up collar and aft side of BH 222 may result in deployment failure.

4. Verify minimum gap of 0.40 inch (10.16 mm) exists between outer diameter of pick-up collar and aft side of BH 222.

M. *Serials SR20-1423 thru 1624, Serials SR22-0821 thru 1840:* Perform Procedure - CAPS Rocket Assembly Installation. (See Figure 02)

CAUTION: Ensure the exact stackup of the attaching hardware, noted during disassembly, is replicated during reassembly.

Note: To facilitate rocket assembly installation, place rocket assembly inside access panel CB7 on BH 222 prior to cross beam installation.

1. Position rocket assembly in access panel CB7.
2. Install bolts and washers securing cross beam to BH 222.
3. At the top of the parachute assembly, locate and feed the lanyard aft, towards the stowage pocket in the parachute assembly, to facilitate recoiling.

   CAUTION: Do not snag rocket assembly on parachute or surrounding structure while installing.

4. Position rocket motor assembly to CAPS compartment. Install bolts and washers.
5. Install bolts, washers, and nuts securing rocket assembly bracket to BH 222 cross beam.

   WARNING: Incorrect gap between outer diameter of pick-up collar and aft side of BH 222 may result in deployment failure.

6. Verify minimum gap of 0.40 inch (10.16 mm) exists between outer diameter of pick-up collar and BH 222.

N. *Serials SR20-1625 thru 1798, Serials SR22-1841 thru 2437:* Perform Procedure - CAPS Rocket Assembly Installation. (See Figure 03)

CAUTION: Ensure the exact stackup of the attaching hardware, noted during disassembly, is replicated during reassembly.

Note: To facilitate rocket assembly installation, place rocket assembly inside access panel CB7 on BH 222 prior to cross beam installation.

1. Position rocket assembly in access panel CB7.
2. Install bolts and washers securing cross beam to BH 222.
3. At the top of the parachute assembly, locate and feed the lanyard aft, towards the stowage pocket in the parachute assembly, to facilitate recoiling.

CAUTION: Do not snag rocket assembly on parachute or surrounding structure while installing.

4. Position and secure rocket motor assembly to BH 222 cross beam with bolts and washers.

WARNING: Incorrect gap between outer diameter of pick-up collar and aft side of BH 222 may result in deployment failure.

5. Verify minimum gap of 0.40 inch (10.16 mm) exists between outer diameter of pick-up collar and aft side of BH 222.

O. Perform Procedure - Post Inspection.

1. At the top of the parachute assembly, locate and feed the lanyard aft towards the stowage pocket in the parachute assembly. Continue feeding lanyard aft until slack is removed and the lanyard is coiled back into the stowage pocket in the parachute assembly. Ensure lanyard coil in the stowage pocket is not twisted.

WARNING: Verify rocket lanyard is positioned around top outside diameter of pick-up collar support, NOT over top of the rocket. Failure to comply will absolutely FAIL rocket deployment!

2. Verify rocket lanyard is positioned around top circumference of pick-up collar support.
3. Verify pickup collar assembly is properly seated to the anchor blocks.
4. Verify rocket lanyard is engaged with the retaining grooves on the pickup collar assembly.
5. Remove catch cloth from below rocket and parachute assembly.
6. Carefully feed spiral wrap cable into adjustable bushing pass-through hole until slack is removed.
7. Reposition CAPS harness.
8. Using a vacuum cleaner, remove all debris from fuselage floor.
9. Visually inspect CAPS compartment for security, leaks, loose or missing hardware, and general condition.

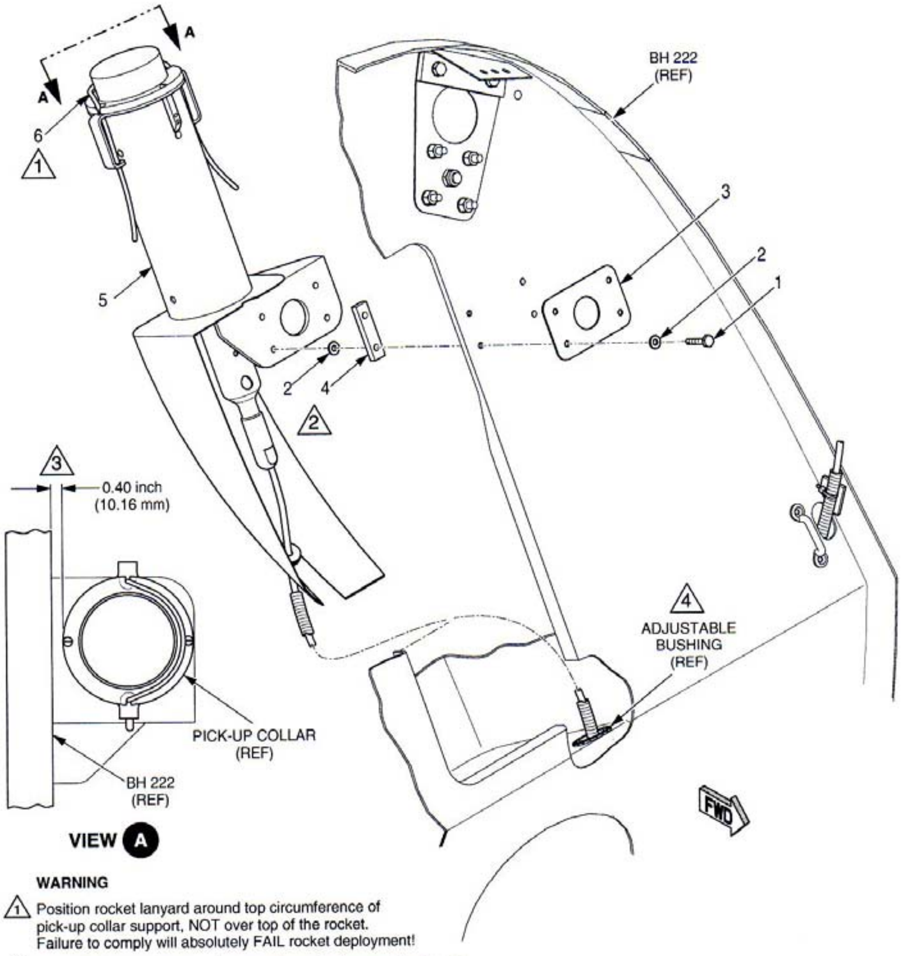
P. Install access panels CB7 to BH 222. (Refer to AMM 6-00)

Q. Install BH 222 trim panel and carpet. (Refer to AMM 25-10)

R. Send completed Compliance Response form to Cirrus Design Customer Service.

S. Complete airplane records by noting compliance with SB 2X-95-10 in Aircraft Logbook.

T. Complete the online Cirrus Warranty Credit Claim Form at:
http://www.cirrusdesign.com/servicecenters/warranty/warrantyclaim/



WARNING

⚠1 Position rocket lanyard around top circumference of pick-up collar support, NOT over top of the rocket. Failure to comply will absolutely FAIL rocket deployment!

⚠2 Due to differing tolerances between the rocket assembly shelves, quantities of shims/washers may differ from those depicted in the figure. Ensure the exact stackup of the attaching hardware is noted during disassembly and then replicated during reassembly. Failure to do so may result in an incorrect rocket installation and subsequent deployment failure.

⚠3 Incorrect gap between outer diameter of pick-up collar and aft side of BH 222 may result in deployment failure.

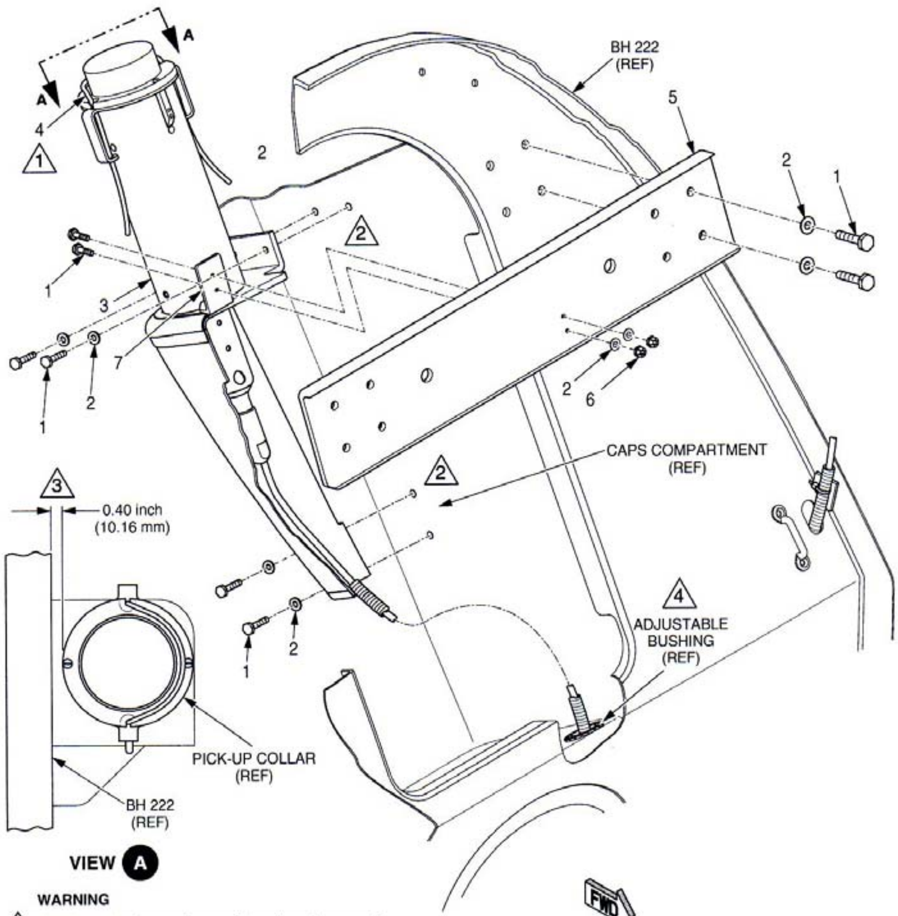
NOTE

⚠4 To facilitate rocket assembly removal, move CAPS harness to either side and carefully pull spiral wrap cable from adjustable bushing pass-through hole as required.

LEGEND
1. Bolt
2. Washer
3. Backing Plate
4. Shim
5. Rocket Assembly
6. Rocket Lanyard

SR2_SB95_1199

Figure 01 - CAPS Rocket Installation - *Serials SR20-1005 thru 1422, SR22-0002 thru 0820*



WARNING

⚠1 Position rocket lanyard around top circumference of pick-up collar support, NOT over top of the rocket. Failure to comply will absolutely FAIL rocket deployment!

⚠2 Due to differing tolerances between the rocket assembly shelves, quantities of shims/washers may differ from those depicted in the figure. Ensure the exact stackup of the attaching hardware is noted during disassembly and then replicated during reassembly. Failure to do so may result in an incorrect rocket installation and subsequent deployment failure.

⚠3 Incorrect gap between outer diameter of pick-up collar and aft side of BH 222 may result in deployment failure.

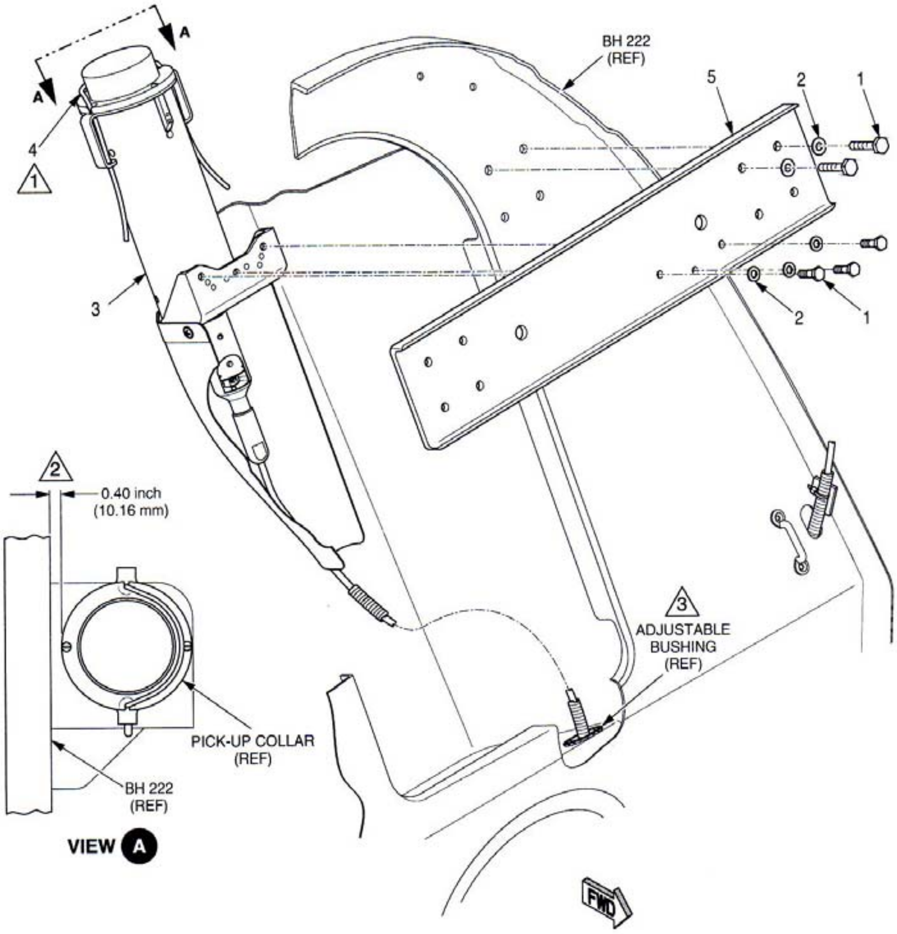
NOTE

⚠4 To facilitate rocket assembly removal, move CAPS harness to either side and carefully pull spiral wrap cable from adjustable bushing pass-through hole as required.

LEGEND
1. Bolt
2. Washer
3. Rocket Assembly
4. Rocket Lanyard
5. Cross Beam
6. Nut
7. Bracket

SR2_SB95_1200

Figure 02 - CAPS Rocket Installation - ***Serials SR20-1423 thru 1624, SR22-0821 thru 1840***



WARNING

1 Position rocket lanyard around top circumference of pick-up collar support, NOT over top of the rocket. Failure to comply will absolutely FAIL rocket deployment!

2 Incorrect gap between outer diameter of pick-up collar and aft side of BH 222 may result in deployment failure.

LEGEND

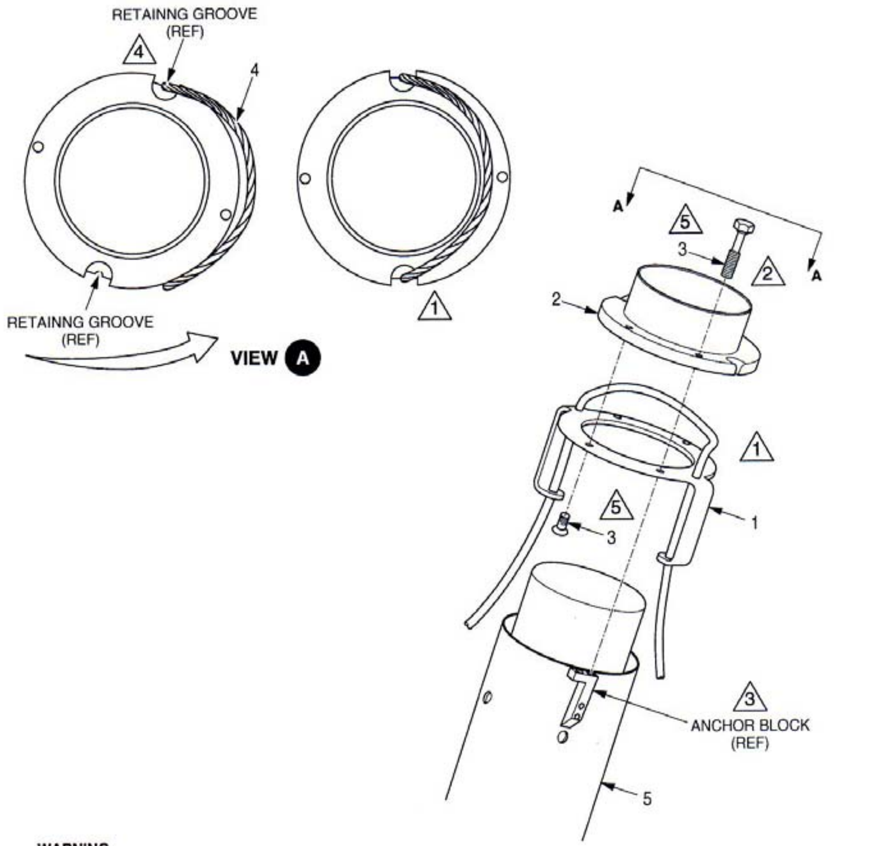
1. Bolt
2. Washer
3. Rocket Assembly
4. Rocket Lanyard
5. Cross Beam

NOTE

3 To facilitate rocket assembly removal, move CAPS harness to either side and carefully pull spiral wrap cable from adjustable bushing pass-through hole as required.

SR2_SB95_1201

Figure 03 - CAPS Rocket Installation - *Serials SR20-1625 thru 1798, Serials SR22-1841 thru 2437*



WARNING

⚠1 Position rocket lanyard around top circumference of pick-up collar support, NOT over top of the rocket. Failure to comply will absolutely FAIL rocket deployment!

CAUTION

⚠2 Do not overtighten aluminum tension screws. Tighten aluminum tension screws until snug.

⚠3 Verify anchor blocks are perpendicular to pick-up collar assembly. If pick-up collar assembly is not fully seated against the anchor blocks, use pliers to gently adjust anchor blocks as required.

NOTE

⚠4 Position retaining groove of pick-up collar support to rocket lanyard. Pivot pick-up collar support until the rocket lanyard engages the opposite retaining groove.

⚠5 Apply threadlock to screws.

LEGEND
1. Pick-up Collar
2. Pick-up Collar Support, Improved
3. Screw
4. Rocket Lanyard
5. Rocket Assembly

SR2_SB95_1202

Figure 04 - CAPS Rocket Assembly